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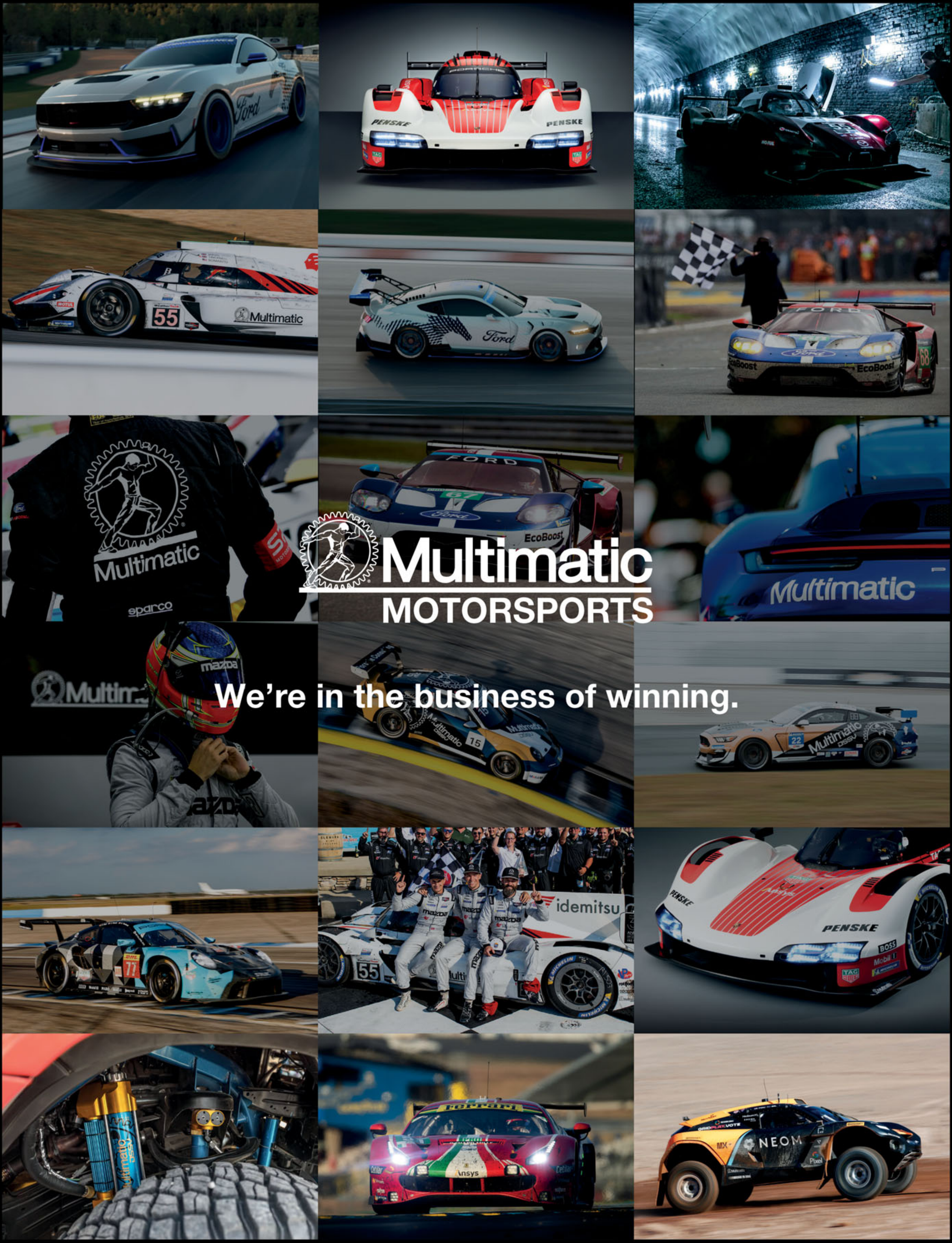
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THE QUEST FOR THE BEST

I WAS once naïve enough to ask Sir Frank Williams which F1 race meant the most to him. A drum roll echoed inside my head as I eagerly anticipated the answer. “The next one,” he replied, deadpan, without hesitation.

That driven, single-minded approach doesn’t fill a journalist’s notebook, but will resonate with any who have achieved success in Formula 1. It is also why the FIA’s aero team hasn’t wasted any time revelling in the success of the new car introduced for 2022, but instead moved straight ahead to the next challenge: developing a car for the 2026 ruleset.

Sir Frank is revered within the sport as a real racer. The irony, of course, is that for long periods of his team’s reign, the aerodynamic development of the cars meant they couldn’t actually *race*! That’s why I found this month’s cover feature, with FIA Head of Aerodynamics Jason Somerville, so fascinating.

The scale of the research that underpinned the project – regulations that would both reduce the cars’ sensitivity to turbulent air and minimise the wake directed towards following cars – is staggering: 21 different design baselines, each with countless iterations, were evaluated in CFD.

As if straight out of *A Christmas Carol*, the aero team even visited the ghosts of rulesets past and present, as well as peering into the future. What they discovered is that F1’s best racing through the ages derived not from the pursuit of any magic technical direction, but was more likely born from good fortune amid a series of reactive rule changes.

We live in the ‘Drive To Survive’ era, and Formula 1 takes a lot of criticism for what is perceived increasingly to be a Reality TV feel. But I have to admire this pursuit of cars that can actually deliver close racing. The research into suppressing the spray kicked up in extreme wet conditions (featured on page 6) is born of that same desire to deliver a racing spectacle.

NASCAR reinvented itself at the same time as Formula 1. Its Next Gen car is the product of the biggest upheaval in stock car racing history. As with F1, that innovation has been rewarded with improved racing and a closing of the gap between the Haves and Have-nots.

Europeans will get their first glimpse of the new car in June, when the Garage 56 Chevrolet (see page 28) takes on the challenge of the Le Mans 24 Hours. But they will hear it first!

The team behind the car, like its suppliers, have gone to extraordinary lengths to prepare it for running 24 hours, while still preserving the DNA of a NASCAR. The car is a monster. Don’t miss it.

Mark Skewis
EDITOR

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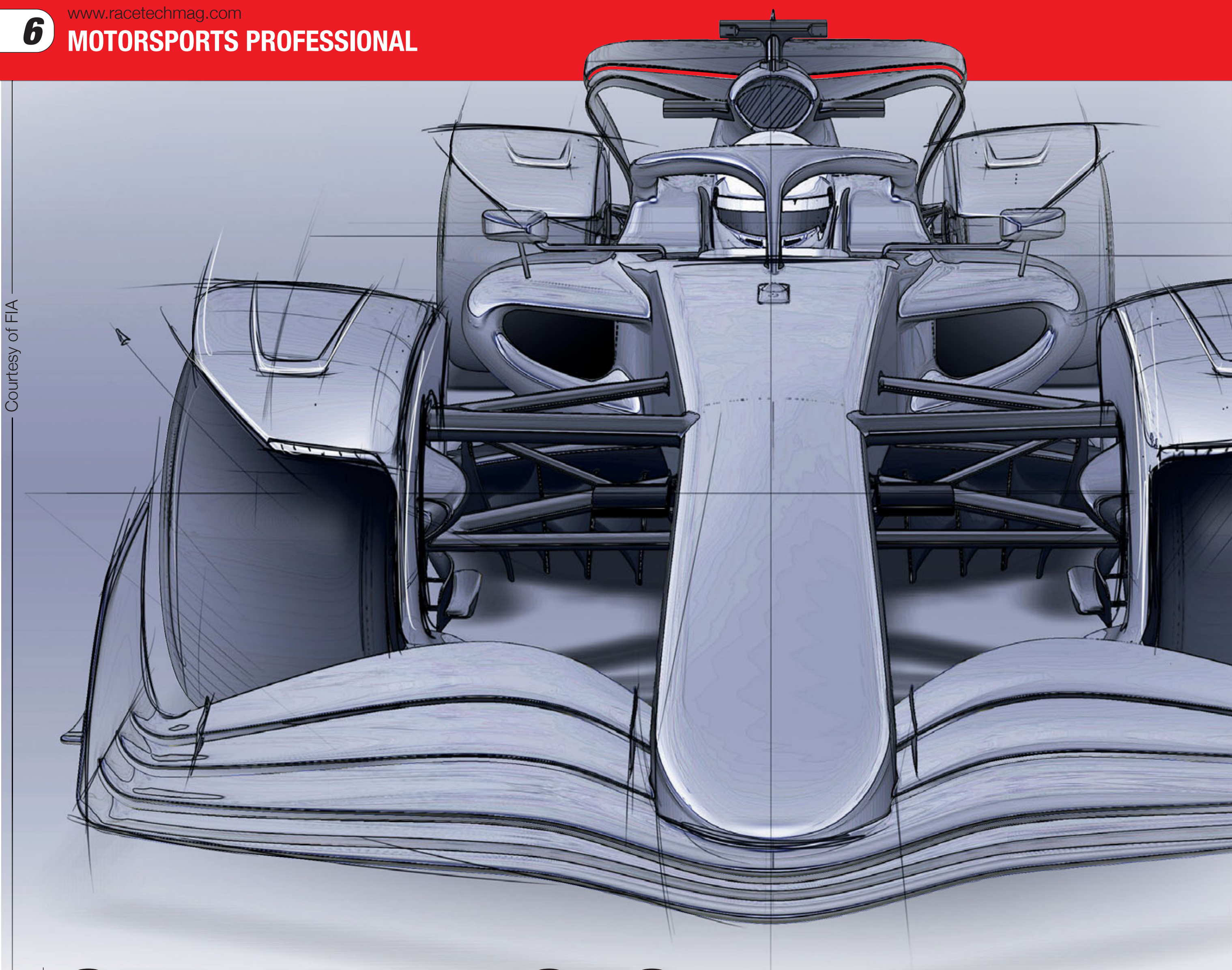


Courtesy of FIA

CFD ADVANCES PAVE WAY FOR WET WEATHER BODY KIT

A complex F1 research project has the potential to revolutionise racing in the rain. By **Mark Skewis**

FORMULA 1 is pressing ahead with ground-breaking research that could lead to a wet weather body kit that enables cars to race more easily in heavy rain.

The sport is still haunted by the spectre of the 2021 Belgian Grand Prix, the shortest 'race' in world championship history. Sporting regulations were altered in the wake of the debacle, where half points were awarded after long delays culminated in only a couple of laps which were run behind the safety car.

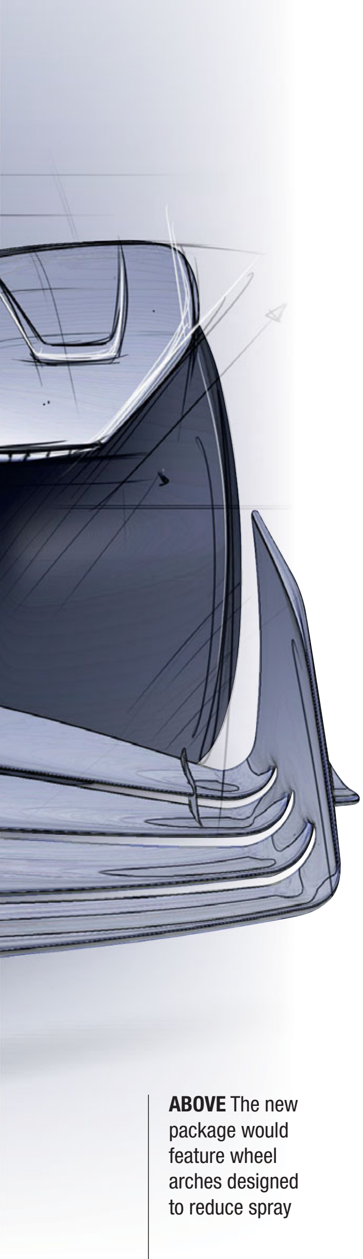
The aero team responsible for the successful introduction of the new generation F1 car last season has, for some time, been conducting research into how it could improve cars' ability to race in the rain.

The new aerodynamics did, as intended, both reduce the cars' sensitivity to turbulent air and minimise the wake directed towards following cars. Whilst this has improved the ability to race in close proximity in the dry, driver feedback has indicated that the changes have also led to reduced visibility in extremely wet conditions. This has been a key determinant on starting, or needing to suspend sessions during wet events.

CFD to the rescue

The use of Computational Fluid Dynamics (CFD) truly came into its own during the five-year development of the new cars. Twenty-one different design baselines, each with countless iterations, were evaluated in CFD.

In total, around 7,500 CFD simulations were run, taking somewhere in the region of 16.5 million core hours to solve. F1 sources calculated that would have taken



ABOVE The new package would feature wheel arches designed to reduce spray

471 years to process on a high-spec Intel i9 quad-core laptop, but the aero group called upon the might of Amazon's AWS cloud computing platform, not to mention the teams themselves who were granted special dispensation to carry out specific work outside of the restrictions laid down by the Aerodynamic Testing Regulations (ATR).

Now the FIA has developed some bespoke techniques with its CFD partners, UK-based TotalSim CFD and Catesby Projects, which enable it to simulate how particles (water droplets) picked up by the tyres travel downstream.

The complex method, known as Lagrangian particle tracking (LPT), deals with a mixed fluid flow of air and water. It effectively simulates an airflow into which water particles are then injected and tracked.

The wet weather running study has benefited from crucial input from both industry and academia, with JLR and Loughborough University each offering expertise in the field.

The research has indicated that it is possible to positively influence the trajectory of the particles, with the comparison between baseline and development cases showing some encouraging trends.

The new regulations are the most CAD-literate in the sport's history. Not only is this useful to police the cars' legality, but it means it is easy for the governing body to share its baseline CAD geometry with the F1 teams, enabling them to run their own CFD. This was the case during the development of the 2022 aerodynamics, and the collaboration will be renewed this year to hasten the development of a potential wet weather bodywork package.

The intention is to define a standard bodywork kit, aiming to suppress the tyre spray from running in wet conditions by use of minimal bodywork – wheel arches – over the wheels. A crucial part of the design process will be to ensure the arches do not hinder pitstop tyre changes.

> *"It effectively simulates an airflow into which water particles are then injected and tracked"*

The devices would only be fitted either before a race or during a red flag due to extreme wet conditions.

New Pirelli tyre

The first 2023 meeting of the Formula 1 Commission, in London ahead of the start of the new season, addressed the wet weather issue. Chaired by Formula 1 President and CEO Stefano Domenicali and newly-appointed FIA Single-Seater Director Nikolas Tombazis, it revealed that following successful testing, with the support of teams, Pirelli is to introduce a new wet weather tyre which is much more performant than the previous specification. This tyre does not require the use of tyre blankets – something the FIA is attempting to phase out.

The new tyre construction will be available from the 2023 FIA Formula 1 Emilia Romagna Grand Prix.

Additionally, the FIA has already received offers from teams willing to support research on the wet weather project. A Technical Directive is being prepared to allow teams to do such work outside the Aerodynamic Testing Restriction (ATR) limits and outside the cost cap.

Track testing to validate the CFD results is planned for the second or third quarter of 2023, with any successful geometries phased in no sooner than 2024. RT

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RIGHT Driver feedback is that the modified wake of the new-generation F1 cars (here Mercedes-AMG's W14 is seen on shakedown) worsens visibility for following drivers

Scramble for 2026 powertrains as Honda considers return

HONDA has been approached by a number of Formula 1 teams as the scramble for 2026 Power Unit supply intensifies.

Mercedes, Ferrari, Red Bull, Alpine and Audi are all committed to their own engine projects for the introduction of new regulations in 2026. But Honda's registration for F1's new, more sustainable era, added a wildcard element to the situation – and teams weren't slow to react to the opportunity.

"After we made the registration, we have been contacted by multiple F1 teams," admitted Honda president Koji Watanabe at a press briefing ahead of the new season.

McLaren was among the suitors, keen on rekindling its relationship with the Japanese manufacturer, but there were understandably other admirers too of a company whose powerplants won 17 races last season with Red Bull.

The company officially pulled out of F1 at the end of 2021, although its engines are still used by the two Red Bull teams and will be called Hondas again in 2023.

BELOW Honda is considering a formal return to Formula 1

HONDA
RedBu

"For the time being, we would like to keep a close eye on where F1 is going and just see how things go," said Watanabe. "We don't have any concrete decisions on whether we will be going back."

The new F1 regulations will see the sport continue with 1.6-litre turbo hybrid engines, but with a change in architecture to simplify the technology. There will be a significant increase in the proportion of power provided by electricity, and the use of carbon-neutral synthetic fuels.

Honda has not yet formally committed to entering F1 from 2026 but Watanabe said the new rules were appealing as they aligned with Honda's corporate strategy: "Formula 1 is greatly shifting towards electrification. Given that carbon neutrality is our corporate-wide target at Honda, we think F1's future direction is in line with our target. That is why we have decided to register as a manufacturer of a power-unit.

"We are curious about where F1 is going and how is that going to look with more electrification happening. We would like to keep a very close eye on that and that is why we have decided to register as a PU manufacturer."

Honda's decision to officially withdraw from F1 at the end of 2021 was made on the basis that it wanted to divert resources towards pursuing carbon-neutrality through "future power unit and energy technologies, including fuel-cell vehicle and battery technologies". At the time, the decision sent shockwaves through F1, undoubtedly playing a role in the decision to embrace sustainable fuels and greater electrification, while pinning its colours firmly to the ICE mast.

Subsequently, Audi has been tempted in and Ford has agreed a tie-up with Red Bull when Honda's deal with the reigning world champions expires in 2025. Honda's admission that it is contemplating a formal return in 2026 further underlines the success of F1's sustainability drive.

The best gets even better

Tetsushi Kakuda, Honda's F1 project leader and executive chief engineer, told reporters the company had worked to address reliability issues for 2023.

"Last year I believe all the power unit manufacturers prioritised performance in their development, and so did we," he said. "We made every effort to recover the performance lost due to the E10 fuel introduced by the regulation change.

"But as a result, the internal load to the engine increased significantly compared to the previous year and the reliability was severely compromised. As a result several problems surfaced during the 2022 season."

He said Honda had further optimised control and energy management and worked with suppliers to improve the precision of parts and power unit assembly. RT

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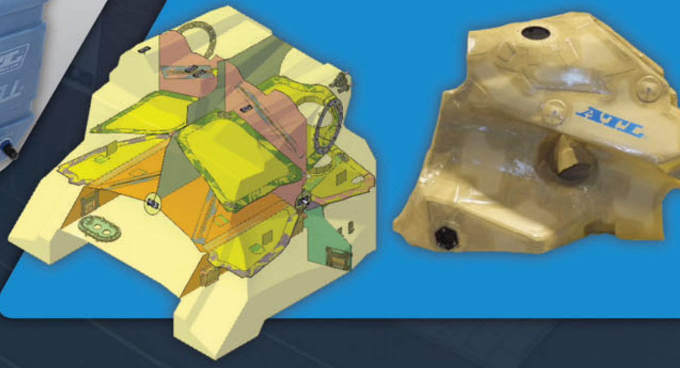

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Le Mans treated to “the full NASCAR experience”

ABOVE The Chevrolet has a special entry in the 100th-anniversary edition of the 24 Hours of Le Mans

NASCAR chairman and CEO Jim France has promised fans that the Garage 56 stock car racing at this year’s Le Mans 24 Hours will offer ”the full NASCAR experience”.

Talking at the unveiling of the car’s livery, he reported: “From the beginning of this project, it was important to us that the car we bring to Le Mans is a true NASCAR stock car.

“While there have been some adjustments to allow the car to compete in a 24-hour endurance race, fans in Le Mans will be treated to the full NASCAR experience.”

Some of the car’s specifications, based on the Next Gen vehicle that races in the NASCAR Cup Series, were revealed at the launch. The total weight of the Garage 56 car tips the scales at 2,960 pounds, significantly less than the 3,485 pounds of the current Cup Series racer.

Chad Knaus, Hendrick VP of competition, said the target horsepower figure for the car is rated in the “high seven hundreds”.

The G56 entry also carries project-specific Goodyear Eagle racing tyres and special aerodynamic devices – dive planes, plus a more robust front splitter and rear diffuser – which have been featured on the test car. That includes a taller rear spoiler – six inches vs. the four-inch spoiler on the current Cup Series configuration. The fuel cell is also larger: 32 gallons for Garage 56, compared to 20 gallons for the Cup Series.

Knaus said trimming weight from the car was a cumulative effect of measures taken from top to bottom. He added that with a full fuel load, the car weighs in near the 3,250-pound range.

“Everywhere, honestly,” said Knaus. “We’ve worked with all of our partners, all of the single-source parts providers from NASCAR, whether it be BBS, AP with the brakes, you go all the way to the shocks, it’s all the way across the board. Everybody pitched in, and we got to work on this program. Everything on the car has been lightened up to the best of our ability – Dallara and us and the folks at NASCAR worked really hard on just about everything. It’s got composite disc brakes. The wheels are lighter than what the NASCAR Cup wheel is. So really front to back. Five Star stepped up, they got us lighter body panels. It’s everywhere. It’s not just one thing, it’s the whole thing.”

Though the car will feature functioning headlights and taillights for the 24-hour endurance classic, the systems and components on the Le Mans model are very similar to the Next Gen car.

In a mild surprise, the Garage 56 car specifications also will include the same naturally aspirated, cast-iron small block V8 engine as the Cup car.

“Everybody in our company has touched this car,” said team owner Rick Hendrick. “So it’s been a major undertaking, but I’m really proud of it, and it’s gonna be fun to watch it over there. I’m gonna be nervous; we’ve got to run 24 hours, but I’m super excited.”

“It’s not as awe-inspiring for me because I’ve had my hands on it the whole time,” Knaus said. “So you guys are seeing it for the first time, but when they flicked the lights on there and pulled the cover off of it, I was like, ‘Man, that’s a proper race car right there.’ With the way Greg (Ives, crew chief) and Ben (Wright, G56 program manager) and the whole group are working together on this project, I think the folks in Europe are really going to be impressed what the NASCAR community’s capable of putting on the race track. It’s a really clean race car.”

The project has undergone extensive development and testing since its launch last March at Sebring International Raceway. The Camaro ZL1 has completed more than 3,600 miles, including a 24-hour test at Sebring. RT

“YOU’LL HEAR US COMING...”

NASCAR AT LE MANS
See Page 28

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LEFT The 2023 Next Gen design, which made its race debut at Daytona, has been improved after analysis at NASCAR's R&D Center

NASCAR improves Next Gen safety

NASCAR has taken on board the lessons it learned with the introduction of its Next Gen car last season, sparking further innovation around the vehicle and its construction in order to improve safety.

For 2023, teams will utilize new centre and rear 'clips' on the vehicle's chassis. Both sections have been modified to better absorb rear impacts following crashes in 2022 that resulted in concussions for two playoff-eligible drivers.

Kurt Busch, the 2004 Cup series champion, was injured after backing his Toyota into the wall last July at Pocono Raceway. Two months later, Alex Bowman incurred a concussion upon backing his Chevrolet into the wall at Texas Motor Speedway.

NASCAR worked closely with Technique Chassis, which provides all Cup teams with their chassis components, to improve the crush zones of the rear end and alleviate the energy that has deflected to the driver in rear impacts.

The improved 2023 design features the removal of some bars, a reduction in the thickness of some tubing and adding pivot points called "triggers" in the structure to encourage deformation while protecting both the oil tank and fuel cell.

"It's not any one of those things by themselves that was the key," explained Dr John Patalak, NASCAR's vice president of safety engineering. "It was the cumulative effect of the whole assembly working together. And so this was kind of the final validation of that. All of those changes were put together through computer modelling all sorts of different crash scenarios at the race track."

A focal point of the new construction was creating zones that would crumple more easily to absorb energy.

"We took the rear bumper struts," Patalak said. "They're made out of aluminium, and so they're made out of thinner gauge than they previously were. So they collapse at a lower load; their buckling loads are lower.

"And then the rear clip, we removed and/or replaced structures with different cross-sections, meaning we weakened the structures so that they would deform under less load. And you have to be very specific and careful where you do that so that we don't introduce problems in other circumstances where you don't want it to bend or where you can't have it bend."

Additionally, NASCAR is mandating new incident data collection systems on all Cup Series cars for 2023.

"In 2002, we started with our black box or our incident data recorder that goes on the left frame rail [of the chassis]," Patalak said. "There's been several iterations over the years. In 2018, we added a high-speed camera. So this year in Cup, it is a completely new system from the ground up. This will give us more data channels, will give us dedicated GPS data as far as the speed of the vehicle, and we'll have a lot of those things all synchronized in time. So when we do our crash analyses, we will have a more powerful data set to work with."

Some drivers will also wear mouthpiece sensors this season, continuing use from 2022. These sensors are used on a voluntary basis but Patalak noted an increase in the number of drivers who are electing to use them beginning in 2023.

"We talked about the data recorder, it's on the chassis of the car. So that's what the car is experiencing," Patalak said. "But ultimately, what we want to do is make the driver as safe as possible. So this gives us a data point from the drivers, from their body themselves. And that's informative on our computer model in our testing, whether we're using crash test dummies like physical dummies in the crash lab, or doing human body modelling, numerical simulation, it makes all of that research better. It gives us more confidence in what tools we use. It helps us when we go to make changes and evaluate better strategies."

More work has gone into evaluating the proper configuration of SFI-approved foam that surrounds the driver's head within the cockpit as well, specifically addressing the most effective heights, positioning and gaps that best protect the drivers' heads in a crash. RT

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> "This was my first time attending the World Motorsport Symposium and it was an overwhelmingly positive experience. The quality of people, content and discussions were at the highest levels but the camaraderie amongst those in attendance really stood out. I plan to mark it on my calendar now for 2023 and bring several people from NASCAR to attend. Can't wait"

ERIC JACUZZI, Managing Director, Aerodynamics/ Vehicle Performance, R&D Center, NASCAR

> "Racing is the fast track to the adoption of advanced technologies on the road but the path from race to road is only open if knowledge is shared"

PAT SYMONDS, Chief Technical Officer, F1

> "After the sad years of COVID, it was a pleasure to meet the motorsport community again. We share the same passion and are all aware that motorsport has to evolve to green technologies, as we are doing in the ACO with the hydrogen project. These technologies were at the core of all the discussions I had"

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Formula E spawns a feeder series

A NEW all-electric racing series was unveiled at the 2023 Formula E clash in Hyderabad, India, aiming to help drivers and engineers get into competitive motorsport.

Founded by former Mahindra Racing CEO Dilbagh Gill, the ACE Championship will consist of an entry-level Challenger Series and a top-tier Championship. The Championship will act as a feeder and talent development platform for young drivers and engineers seeking to move into more competitive and well-known race series.

"After years of racing, I felt it was time to give something back to the sport. The essence of the whole project is affordability but ensuring the performance of the four-wheelers to be on par with Gen2," Gill said. "ACE Championship is going to focus around the three 'Ds' – we are going to be daring, we are going to be different, and we are going to be digital.

"We hope this will create career opportunities through the roles of the motorsport paddock irrespective of the background, location, gender or socio-economic status."

"Electric avenue"

Electric racing impresario Alejandro Agag has also been involved as an advisor in developing the new series. Agag founded Formula E, the electric SUV racing series Extreme E, and the forthcoming electric powerboat racing series E1, which counts Rafael Nadal and Sergio Perez as team owners. He said: "The ACE Championship is an important initiative. To create opportunities for young drivers to enter motorsport via the 'electric avenue' is crucial – and was missing until now.

"Having more competitions in countries around the world where there is not as much access to and representation in motorsport is key to success. To create this championship in India is a great idea and certainly fills a gap, in a huge market for the automotive industry."

Former F1 and Formula E pilot Nick Heidfeld will be Development Driver and Advisor for the ACE Championship.

Although no specific powertrain has been revealed, the car used in the ACE Championship – which could be the Gen2 Formula E vehicle with revised bodywork – will be similar in performance to a Gen2.

In a world-first, the same car will be used in both levels of the series, with two power levels depending on the series. This will enable teams to have four drivers competing in two championships with two vehicles.

Innovation and opportunity

"The ACE Championship is about innovation in motorsport and about opportunity," said Gill. "We are looking at the ACE Championship to provide representation to people who are interested in driving, and engineers around the world who have not had the opportunity to date, and giving them a chance to level up.

"The bedrock of the ACE Championship is to provide technology, opportunity and a platform to excel. We are providing a pathway for our drivers in the ACE Championship, at a low cost but with high performance."

The series is planned to run in a regional format on circuits across the globe. It will begin in India next year before heading to the Far-East, Europe and America.

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ABOVE & LEFT The ACE Championship was revealed in Hyderabad

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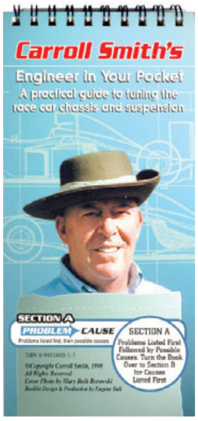
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EXTREME E
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Extreme E in a "race for the planet," says Agag

ABOVE Extreme E introduces a revised race format for its third campaign

ON the eve of Extreme E's biggest campaign yet, Alejandro Agag, CEO and Founder of the series, has urged all involved not to lose sight of the championship's goals.

"With all this excitement we cannot lose sight of our overall purpose – this championship is a race for the planet," Agag said. "We are determined to build on the success our platform has had in raising awareness of climate issues and we are ready to take things even further as we explore the sustainable solutions that we can all be part of."

Extreme E's third season sees the introduction of a new racing format – showcasing double the racing action with no additional carbon footprint. Each X Prix will now be a double-header and play host to back-to-back rounds across the weekend.

"We've continuously improved the racing spectacle since launching Extreme E, but for Season 3 we wanted to create something spectacular and we feel this new sporting format achieves that," commented James Taylor, Chief Championship Officer at Extreme E.

"At each round, there will be double the opportunity for points and podiums – drivers and teams will have to navigate that racing tightrope of risk and reward to ensure they achieve the maximum result.

"Having a 10-race championship should really close up those standings as the season progresses, meaning a thrilling Extreme E campaign should be in store for 2023."

Season 3 begins in NEOM, Saudi Arabia. Alongside returning to Saudi Arabia, Sardinia, and Chile, Extreme E will also make its debut in Scotland, and possibly the USA or Brazil.

NEOM is the centrepiece of Saudi Arabia's Vision 2030 plan to grow and diversify the Saudi economy and position the country as a leader in global sustainable development.

NEOM's involvement in Extreme E grew even further last season, becoming the title sponsor at NEOM McLaren Extreme E. The partnership with McLaren Electric Racing builds on NEOM's growing involvement in electric motorsport and aims to establish NEOM as an innovative hub for global sport. A multi-year relationship with ENOWA was also announced, NEOM's energy, water and hydrogen subsidiary, to introduce green hydrogen power to their global sustainable racing series.

ENOWA is the engine room for sustainable energy, water and hydrogen at NEOM. Green hydrogen is widely seen as the most promising green energy carrier for the future. This technology supports the transportation of renewable energy over long distances and the decarbonisation of major industries and infrastructure. Both work to implement innovative green hydrogen-based technologies to not only power the championship towards a 100 per cent "leave no trace" ambition but also to showcase the opportunities around this technology. RT

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Radical SR10 given XXR update

RADICAL Motorsport has upgraded its popular SR10 to SR10 XXR format.

The move came just one month after the latest model, the SR3 XXR, was released, aligning the company's two most popular racecars under the XXR banner.

In addition to new front louvres, the SR10 XXR is fitted with the popular LMP-inspired 'central fin' feature from the SR3 XXR, alongside new lightweight alloy wheels and high-intensity front DRL light clusters; all as standard. For drivers looking for even more weight reduction, a brand-new carbon splitter and diffuser package is available as a cost option.

Joe Anwyll, Radical Motorsport CEO, said: "The SR10 range has continued to push the boundaries of modern engineering capabilities with the same pure Radical driving experience. Our fastest-selling model in our history, and a favourite with US customers in particular, we've been working hard to cherry-pick the best XXR model line upgrades and adding them to our best-selling model, the SR10.

"The last two years have been great to witness, seeing the SR10 be so well received in the track day and country club markets. As well as some impressive styling updates to the bodywork, the addition of the 'central fin' and front louvres have proven to increase the SR10 XXR's usability even more."

Delivering on customer feedback, many of the new SR10 XXR updates will be made available to current SR10 owners in the form of a new 'XXR Evolution Pack'. This will include the XXR's improved aerodynamic upgrades on the front clam, as well as the new wheel design, optimised cooling and revised set-up, and the carbon fibre bodywork items as an option.

Both SR10 XXR and SR10 models with the 'XXR Evolution Pack' will continue to be eligible in international Radical Cup championships within the 'Platinum' classes.

"We're proud of the lower running costs that come with the SR10 XXR's long-life 425 bhp engine, and the elements that produce real-time data, creating the ultimate driver's car," said Dan Redpath, Group Sales and Marketing Director at Radical Motorsport. "Because of this, we made sure to not forget any of the organic SR10 DNA that is already so popular when we set about optimising it further." RT

LEFT SR10 XXR upgrades include a 'central fin', alloy wheels and DRL lights as standard

DK Engineering strikes deal with McMurtry

ABOVE The market launch capitalises on the success of the Spéirling

DK ENGINEERING is to act as the exclusive UK agent for McMurtry, the British engineering outfit whose Spéirling impressed with its record-breaking feats at Goodwood last season.

DK boasts an extensive automotive engineering background and sales of some of the most exclusive vehicles throughout its 45-year history.

James Cottingham, from DK Engineering, explained: "At our core, DK is an engineering company and it is amazing to see what McMurtry are achieving. I love what the team is doing, using electricity, but taking a different approach, rather than simply following the crowd. There is a huge respect for the work they have already carried out and the performance being achieved.

"We feel it will be a great fit with our clientbase – for those who have an electric car scratch to itch, but who haven't been intrigued or interested in anything offered previously. The team is taking the technology to the next level and we are proud to be a part of this exciting journey."

Thomas Yates, Managing Director at McMurtry Automotive, added: "Now we have proven that our downforce on demand technology works and have a world-beating track car, this is the next logical step, launching the Spéirling onto the market. We're looking forward to working with James and his team and know they can bring invaluable experience to the table."

The McMurtry Spéirling fan car has achieved an independently measured 0-60 mph in 1.40s and ¼-mile (400m) in 7.97s during filming for one of YouTube's largest automotive channels, carwow. RT

McLaren releases 720S GT3 EVO

BrandsHatch

ABOVE The Evo features improved aero and serviceability

McLAREN Motorsport has revealed the new 720S GT3 EVO, designed to build on the success of the 720S at the head of the international GT3 field into the 2023 season and beyond.

Available as a new-build race car or as an update package to an existing car, the 720S GT3 EVO will be homologated for the 2023 season. The changes reflect learnings from the 720S GT3, which has been a front running GT3 car from its very first race, and feedback from teams.

The 720S GT3 EVO is distinguished from its predecessor with several key bodywork improvements, including the front bumper and splitter – fitted with quick-release fastenings for easy removal and replacement. These feature improved aerodynamics, designed to increase overall downforce as well as shifting the overall balance forwards and also making the car more consistent in traffic.

A front bonnet gurney also helps with balance and improves cooling performance, while the auxiliary lamp positions have been changed for better night visibility in longer-distance events. At the rear, the wing pylon mechanism can now be easily adjusted, and the rear wing gurney is taller to enhance downforce without upsetting overall balance.

Many more improvements can be found in the 720S GT3 EVO's suspension, which now features all-new TTX40 Öhlins 4-way adjustable dampers with high frequency pistons and adjustable lengths. Both front and rear upper wishbones have been changed, with the front now adjustable to improve tyre management options, including a new clevis for increased droop. The rear has an improved geometry to suit upright changes.

The uprights are also new, with the front featuring a bolted brake caliper for quick changes of whole system as a unit and a built-in track rod clevis, making it more robust in wheel-to-wheel contact situations. This also applies to the rear upright, which also has improved geometry for tyre management, increasing setup options. The 720S GT3 EVO's brakes now have closed face bells for improved disc durability.

Existing 720S GT3 owners and teams can purchase a full update kit with the option to use existing hub units or with the complete upright assemblies.

"The McLaren 720S GT3 has been an incredible success in GT3 racing since its phenomenal debut four years ago, leading the Gulf 12 Hour race for several hours. Since then it has recorded many race wins and championships, most recently titles in the Asian Le Mans Series, IMSA WeatherTech Sportscar Championship and GT World Challenge Europe last year and has begun 2023 with a podium in the Daytona 24 Hours," commented Ian Morgan, Director of Motorsport, McLaren Automotive.

"In that time we've maintained a close relationship with our customer racing teams and have incorporated many of their recommendations into the new EVO package, improving consistency of performance and serviceability, which will ensure that the McLaren 720S will continue to set the pace in GT3 racing for many more years to come." RT

Hybrid power a big winner in BTCC survey

THE Kwik Fit British Touring Car Championship's introduction of hybrid power and a more sustainable fuel received almost universal praise in a recent Fans' Survey.

Conducted in January and February, the survey attracted record numbers, with enthusiasts of all levels participating.

Nearly 80% of fans either strongly agree or agree that the BTCC has taken a very positive step in introducing hybrid power and a more sustainable fuel.

One other statistic that also stood out in the early summary was an increase in women now following the BTCC, with an increase in just one year of nearly 5% of females taking part from the previous survey in 2021. This achieved a male/female split of approximately 60/40, which is a significant – and growing – proportion of female followers.

Alan Gow, BTCC Chief Executive, said: "With the final results summary on some of the topics still being collated, we are proud to have received such an overwhelmingly positive response to our introduction of hybrid power and a more sustainable fuel.

"According to the fans, the BTCC is thriving in areas such as sustainability, equality and entertainment, and we will continue to strive for even greater successes in the future."

Overall, supporters had their say on the likes of the race weekend experience, television broadcasts, media platforms, sponsorship, road cars, environment and sustainability, leisure and lifestyle and many more. RT

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“YOU ARE WASTING YOUR TIME!”

F1’s aerodynamic overhaul sparked some awkward confrontations, but we enter the ’23 season with the cynics converted. **Peter Innes** talks overtaking, porpoising and more upheaval for 2026 with Jason Somerville, FIA Head of Aerodynamics

WHEN Lewis Hamilton stormed past Sergio Perez and Charles Leclerc in a single move at last July’s British Grand Prix, it sent the partisan home crowd wild.

It didn’t end there. The Mercedes, Ferrari and Red Bull continued to dice for the rest of a manic lap, joined by two more cars from behind, all mixing it up together.

Racing. Pure, beautiful racing; the kind of mayhem you might expect to see in karting or rallycross. Definitely not what anyone is used to seeing at the sharp end of Formula 1. And there was one man watching on from the Silverstone paddock who will have enjoyed it even more than most.

It had been five years since Jason Somerville was hired as F1's Head of Aerodynamics and tasked with creating a brand new generation of Formula 1 cars that could, well, race. Now, enjoying a day out with his family and deafened by the screams of 140,000 ecstatic fans, he could allow himself a smile. Frankly he would have been well within his rights to set off on a lap of honour. Here's the thing: they said it couldn't be done.

Dirty air

The story starts with Liberty's 2017 purchase of F1. Its newly-installed technical chief Ross Brawn had long suspected there must be a way to design cars better suited to racing; reducing the effect of dirty air so cars could actually run close together. With his highly-successful team hat on, Brawn never had cause to worry about what happened to the cars scrabbling to catch his. Now the gamekeeper, he had the resources to test this theory out.

"Over the years Formula 1 had become massively aero-dominated, with enormous aero teams," says Somerville. "Although there was a subjective feeling that all this development wasn't helping the racing, we wanted to put some research into it: if this was objectively measurable, how could we make a fresh start? Given a clean sheet, could we design cars that could battle closely?

"Once I joined FOM with Pat Symonds we put together a small aero team, vehicle dynamics team and power unit group – a tiny subset of a typical F1 team, but all with recent F1 experience. Alongside our colleagues in the FIA, we had lots of meetings with teams where we'd map out our plans. The premise was well supported but we had some 'difficult' conversations, with engineers saying: 'That's not possible. These cars generate lots of downforce, so they're going to make a wake. You're wasting your time.'

"Not ones to be put off, we took that as a challenge."

To create a car worthy of a brand new era for F1, Somerville's team ended up with four key targets. First up: competitive grids; they didn't want to end up with haves and have-nots – or leave potential for another loophole like 2009's double-diffuser.

Costs were critical too, as was the overall look of the cars, aiming for "clean and sleek" after an era where no spare surface would last a week before sprouting winglets upon winglets.

Finally, there was the big one: raceability.

Somerville thanks some "benevolent teams" for offering them recent car geometries to serve as a baseline, while they inherited CAD and wind tunnel models from the recently-folded Manor team. These were the basis of their early attempts at developing CFD methodologies featuring two cars.

"That was a big undertaking and not something teams typically bother with," says Somerville. "But it enabled us to run a car following a car at various distances and conditions, both on straights and corners, to quantify what the loss was aerodynamically. It was big…

"At a one-car gap, 10 metres from front axle to front axle, nearly 50 percent of ▶

Ferrari

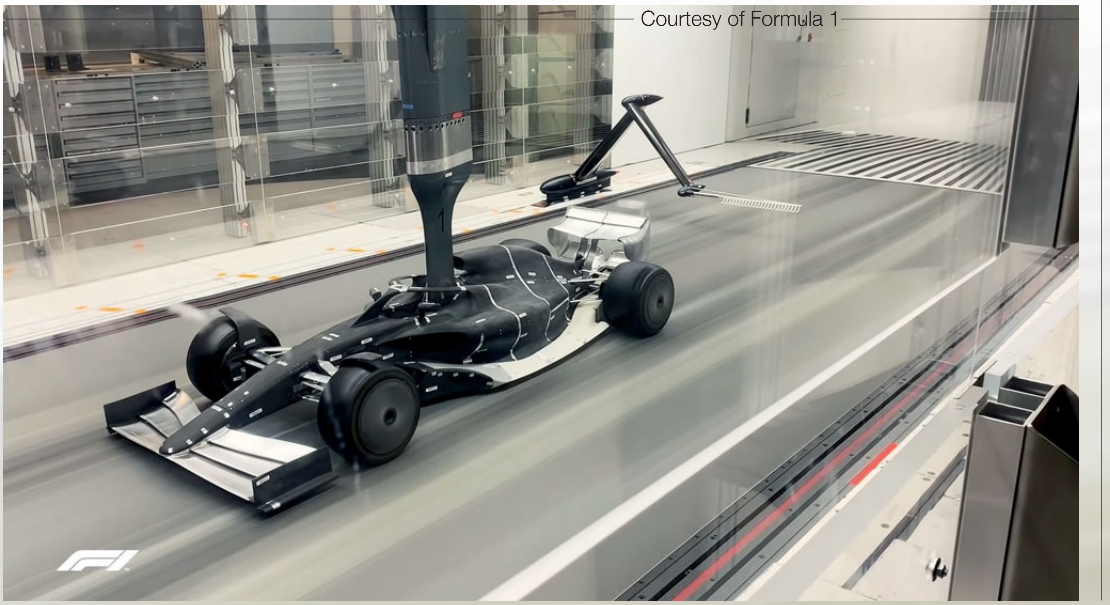
LEFT The design diversity remains for the new season. In spite of some mid-grid convergence, the top teams appear to be pursuing different directions

> ***“There was an easy fix for porpoising but it meant haemorrhaging all the performance you’d just spent nine months extracting”***

the downforce was lost. That’s a massive hit so it was no surprise that we would invariably hear drivers say they’d lose grip when following, or the tyres would overheat so they’d have to back off before another attack. We tested up to 40 metres and there was an impact even at those distances.

“What triggered it was the way the cars generated downforce. Much of the problem originated from the front wheels, so bargeboards and front wing endplate treatments were there to place front wheel wake as far outboard as possible. That suits your own car: if you’re running through your own front wheel wake, you don’t want that to affect the downforce of your underfloor, diffuser or rear wing. But it generates an enormous amount of outwash, so any car following was driving through a large region of low-energy, disturbed airflow.

“Coupled to this was the incredibly high sensitivity of the cars to driving through a wake, largely thanks to bargeboards with elements on elements and front wings with vortex generators. They worked beautifully in clean air – that’s where they were all developed in a wind


Courtesy of Formula 1

LEFT CFD came into its own during the development of the new car but, to ensure the correlation with reality, the wake was interrogated with a robotic probe during tests at Sauber’s wind tunnel

BELOW The five-year journey to create a brand-new generation of Formula 1 cars culminated in remarkable racing at Silverstone tunnel with CFD – but they struggled in dirty air.”

At this point you may be wistfully recalling the F1 era that first made you fall in love with the sport, yelling: “Why can’t they just go back to making them like that?!”

Somerville’s team explored them all, only to find that despite our misty-eyed recollections, there was no single magic formula.

“We not only had an open-minded look at previous F1 generations, we looked at other series,” he adds. “We looked at LMP cars with ground effect and tunnels, IndyCars, even GP2 with its skirted underfloors. But, to our knowledge, none of them had developed their car for following other cars.

Investigating the glory days

“As for F1, some regulation sets were better than others, but it was a more reactive approach than a specific project to find a sweet spot. You might say the era before downforce could be worth going back to; karts, motorbikes and even touring cars race well without lots of downforce. But we didn’t want to start taking wings or underfloors off. We wanted these cars to remain impressive. We weren’t obsessed with lap time, but we didn’t want to add tens of seconds by getting rid of decades of aero contributions.

“What we found more fruitful was deconstructing the current generation of cars: what if we change the front wing or the underfloor? All with the focus of finding ways of controlling the wheel wake without resorting to this fix-all outwash, which was the go-to trick for every team.”

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ABOVE Somerville talked industry experts through ‘F1 2022 – From Targets to Track’ at the Race Tech World Motorsport Symposium

To magic up a car like that with a team of just five people, CFD came into its own, contributing 95 percent of the development, with a total of 7,500 runs – compared to about 200 in the wind tunnel, mainly to validate this CFD. Tapping into the computer resources of partners TotalSim and AWS, they could run ambitious two-car models even as unsteady cornering simulations.

“CFD has come on immeasurably over the years, but the big risk is that you end up going off-piste if you lose correlation with reality,” says Somerville. “So every ▶

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Mercedes-AMG F1 Team

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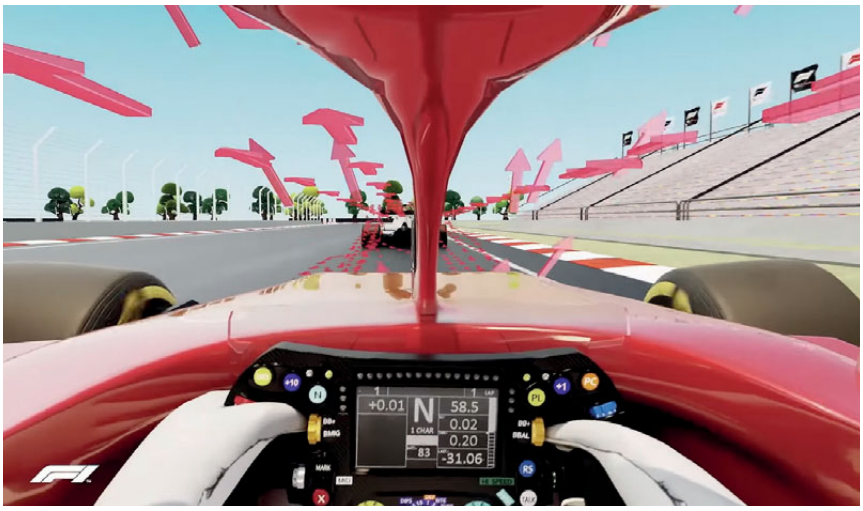


now and again we'd go back to the wind tunnel. We didn't have the chance to run two models in the same session, but we had a set-up at Sauber where we would interrogate the wake with a robotic probe behind the car to double-check what we were seeing in CFD. That was reassuring and let us keep ploughing on.

"We mainly used RANS [Reynolds Averaged Navier Stokes] methodology, which is a cost-effective, efficient way of submitting and calculating a CFD case in various configurations; we could run a two-car case in two hours. A Detached Eddy Simulation (DES) is a far better representation of reality but it can take 12 hours or more, and you live and die by the rate at which you develop. So we used DES as checks on how our progress was tracking."

After all the hours of analysis, hot air and countless combinations of ones and zeros, the eventual solution was a return to ground effect, last run in anger in the early Eighties before being banned. The new car and regulations were originally slated for racing in 2021, but global events conspired into a 12-month delay. That proved useful for Somerville's team, who put poachers' hats on to work out how 10 hyper-competitive F1 teams would set about destroying all their hard-earned raceability gains. Then come January 1, 2021, communication all but stopped as the teams went into flat-out development. All Somerville could do was wait and see what 2022 launch season brought.

"When we published the regulations, teams complained: 'You've taken away all our freedoms,'" he smiles. "But we had to clamp down so we didn't slip straight back into old habits in terms of wake and sensitivity. Even though we're a small aero team there were thousands of configurations tested and lots of behind-the-scenes work with the FIA writing regulations, which is a tough old process. It's like a legal document, and if you don't close down the loopholes you know the blighters on the other side will exploit that and undo it as quickly as they can.

"When the cars did appear we were relieved that they broadly looked like we'd expected – because it had been 12 months of radio silence. We didn't want a grid full of identicars either, so we were pleasantly surprised at the design diversity. For example, we hadn't anticipated the Mercedes with its very narrow, extreme sidepods."

The early feedback from the drivers about running close together at winter testing was promising, albeit with a proviso from George Russell et al about the reduced slipstream.

"During our process we went through various phases of thinking we might be able to remove DRS," says Somerville. "But you're dealing with physics here, so though you've retained more downforce on the following car, that also means we've effectively retained more drag. So the cars are punching a smaller hole in the air for the following car to sit in to generate a tow effect. No surprise there. But all our data showed the benefit of having the grip in the corners was worth more than the loss of the tow on the straight. So, yes, DRS remains important."

Porpoising 'trap'

Mercedes was also among those most affected by the big unwanted surprise of 2022…

"The porpoising caught everybody out,"

Getty Images/Red Bull Content Pool

ABOVE LEFT & RIGHT The fight between Verstappen and Leclerc in Bahrain provided a reminder of something long forgotten in F1: that the battle isn't necessarily over once someone overtakes

LEFT Modifying the disruptive wake of the car in front was one of the aero squad's prime targets

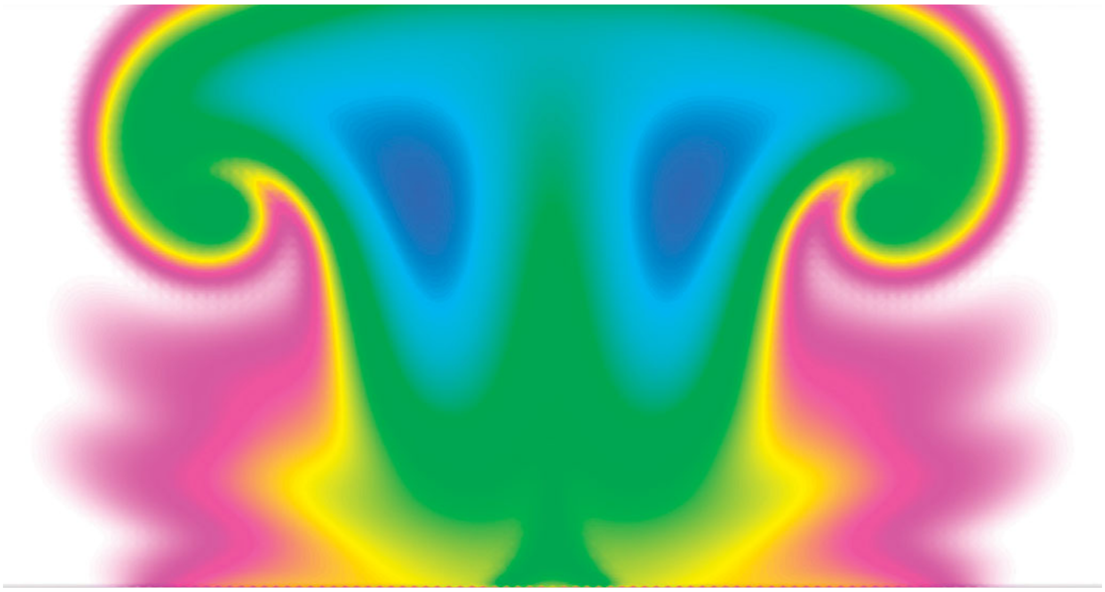
admits Somerville. "We were unlikely to see that in CFD, but we didn't see it in the wind tunnel either, and I don't think any team predicted how extreme it would be. There was a strong incentive to run the cars low as it kept yielding more performance. In hindsight, most teams who did this describe it as a trap, as it wasn't realisable.

"As tracks are never perfectly smooth and bodywork components have finite stiffness, it was nearly impossible to achieve those ultra-low ride heights and ultra-high downforce figures in a consistent manner. So the floor would end up going through a cycle of picking up performance, being sucked to the ground, stalling, then popping back up again. There was an easy fix: move the car away from where the problem was and prop up the ride height. But by doing that you're haemorrhaging all the performance you'd just spent nine months extracting."

Somerville's team had now officially switched from FOM to the FIA, and porpoising was the first issue where they had to intervene – to avoid "compromising driver comfort for performance". He reckons their imposition of an adaptable circuit-by-circuit metric worked, helping the teams regain control over the situation.

As for measuring the all-important effect on wake, Somerville had to rely on glimpses of data from the chassis-top Pitots of yet more "benevolent teams", which confirmed the 'mushroom' had seen a step change from 2021 to 2022. Despite the aero departments' predictable erosion of the benefits as the season went on, the results matched the original ▶

> **"At a one-car gap, 10 metres from front axle to front axle, nearly 50 percent of the downforce was lost"**



RIGHT The 'mushroom' wake (glimpsed here in CFD) is fundamental to the process that guided the design of the new cars. The rotation of the rear wing tip vortices – the 'ears' of the mushroom – pull the car's wake to the centre, then upwards over the following car, like 'gear wheels'

ABOVE The clean aero lines might be slightly disrupted on this season's new cars, but the areas the teams have to play with for generating vortices have so far proven fairly benign

Pirelli

intentions. But the ultimate proof came on the track, notably Charles Leclerc and Max Verstappen's early duel in the desert.

"Bahrain was a really good start to this new era," says Somerville. "We wanted to keep our feet on the ground but seeing the Ferrari and the Red Bull battling corner after corner for a good few laps, we thought: 'It looks like there might be something in this. Perhaps it's not all just ones and noughts and writing legal documents…'

"Something we'd forgotten was that the battle isn't over once someone gets past. That's what we'd been used to seeing in F1: the overtake was difficult but when it happened, they would disappear up the road. The Bahrain experience showed the cars don't need such a large performance delta to pass. So if you do get by, the driver behind still has a chance to have another go at you.

"Later in the year Red Bull really got their car in order so we saw less of it. But as the performance differences start to converge, as should always be the case with steady regulations, we are hopeful that there can be more battles like that in 2023."

The rules have indeed been kept largely consistent for the coming season, with the main change being a 15 mm raising of the floor edge.

"Our dialogue with the teams suggested the floor edge height was order one for triggering the porpoising," he adds. "So rather than having to raise the entire rear ride height by 15 mm, if the regulations meant the rear edge of the underfloor was raised, it gave you protection. It's not a one-stop fix to say porpoising will never happen again, but it will give us more margin. Twelve months on, as a sport we should have a much better handle on that now.

"There's a performance loss in the wind tunnel from that but it's quickly addressed. I expect teams to be back in excess of the downforce levels from last year's car by now. Other than that, they were quite keen that we didn't change too much. They've got used to this set of regulations and in some cases there was a desire to carry components over – though not many because an endless search for performance means that over the course of a winter you won't see much from your previous car."

Heartened

The second year of a new set of F1 regulations usually marks the moment for cars to converge on the same theme. But when Somerville completed his checks before February's Bahrain test, he was heartened to see another relatively wide spread of approaches.

"One big aspect is the bodywork," he says. "Although there's been some convergence among the mid-grid, Ferrari are persisting with their concept and Mercedes have something similar to what they had last year. That indicates either that these aspects don't matter or that they are so far down their chosen development path it's an onerous decision to have to back out and try something else."

As for the look of the cars, now much of the magic is hidden away on increasingly complex floors, are they as clean and sleek as Somerville always intended? Or are the massive aero teams starting to eke out ways to plant their beloved winglets back anywhere they can find?

"These old habits die hard," he sighs. "Last year's cars were fairly clean. The areas the teams can play in are pretty subtle but as teams become more *au fait* with the little opportunities hidden in the regulations, we're now seeing a few little things

LEFT Anxious to avoid leaving another loophole like 2009's double-diffuser, the aero team was left time at the end of the project to revert to their 'team' hats and push the rules as far as they could sprouting out on front wings. There's not so much on brake ducts because they're heavily regulated – apart from the rear. But there are little devices around the halo and mirrors which are subtle and give some visual differentiation between the cars.

"With big items such as sidepods, you've got three different camps. The lion's share of performance is from the underfloor, which isn't often shown. But we're reasonably happy that the areas the teams have to play with for generating vortices have so far proven fairly benign to the racing aspirations…

"Every so often we'll take a peek to make sure, because it would be a real missed opportunity if we allowed everything to fall back to racing that is compromised. We want to push on with all the new fans and interest currently around F1. We can't expect people to sit and watch tediously dull races weekend after weekend. They won't all be classics, and even last year we had some races that were a bit dry. But we do want to ensure the cars aren't working against these close battles."

As the FIA Head of Aerodynamics, Somerville now splits his role between policing the current cars to make sure they don't veer too far from the pure racing ideal, and putting his research and development hat back on for the next big project. As ever, racing comes first.

'DRS Plus' for 2026 car

"Although it feels like the dust has only just settled on these new cars, we're well underway with the next generation of cars based on the new power unit for 2026," says Somerville. "That means another big aero upheaval, mainly because the new power unit has a 50-50 IC-electrical balance. When you look at a simulation of a car with more electrical power and less IC, there are heavy compromises to lap time and top speeds unless you can change the underlying aerodynamics.

"You need to create downforce when you need it and you need a lot less drag when you don't. This has driven us towards looking at alternative concepts, demanding more active aerodynamics so we can pitch the downforce on when we need it, then seriously drop it when we're power-limited. So it's like a 'DRS Plus'. That would be something all cars use to ensure they can race in this new environment. We can't just shoehorn a new power unit into the car because the racing wouldn't be at the level we'd want.

"Let's not forget that at the end of the day it's entertainment. We get a heavily-biased narrative from the engineers who may feel the regulations are too restricted or not as exciting as they could be. But we have to step back and remind ourselves who we're doing this for. It's not just to keep engineers off the streets. It's to make F1 an interesting spectacle for people around the world to get behind." RT

ABOVE The new cars were found to offer a reduced tow to the car behind, which meant retaining the DRS, but it was a price worth paying

Getty Images/Red Bull Content Pool

"YOU'LL *HEAR* US COMING..."

Two worlds collide this June when NASCAR's Garage 56 Camaro tackles the Le Mans 24 Hours. Brandon Thomas, NASCAR's vice president of vehicle design, reveals some of the astonishing work taking place behind the scenes. By **Chris Pickering**

THE summer of 1976 was famously one of the hottest on record. Even by the middle of June, with spring having barely given way to summer, it was blisteringly hot as the 44th running of the 24 Hours of Le Mans began. Waving the starting flag that year was NASCAR boss Bill France Jr, with series founder 'Big' Bill France Sr also present.

They were there to see the fruition of a plan which had been hatched the year before to bring NASCAR to Le Mans to celebrate 200 years of American independence. A Ford Torino and a Dodge Charger were shipped over for the event, with a heavyweight driver line-up that included NASCAR legend and Carrera Panamericana winner Hershel McGriff, French sportscar ace Marcel Mignot and Dick Hutcherson who'd already been on the Le Mans podium with the Ford GT40 in 1966.

On the track, the NASCAR teams were plagued with bad luck from the moment they arrived. Both struggled with the low octane fuel available in France at the time, with the Dodge's engine expiring spectacularly after just two laps. The Ford soldiered on for 11 hours until its transmission failed, and it came to a stop on the far side of the circuit.

It wasn't exactly the result that the NASCAR boys had been hoping for, but in other respects the trip had been a success. The two vast stock cars – looming over the little Lolas and Porsches like basking sharks in a tank full of piranhas – had proved a huge hit with the French fans, who'd affectionately christened them *Les Deux Monstres*. Even so, there must have been a sense of unfinished business as the teams packed up and headed home.

This summer, 47 years later, NASCAR is returning to La Sarthe with another all-star line-up and a specially built Next Gen Chevrolet Camaro developed by the series' own technical department in collaboration with Hendrick Motorsports, Chevrolet, IMSA, and Goodyear.

The car will run in the experimental Garage 56 category that's previously played host to such gloriously madcap creations as the DeltaWing, the petrol-electric Nissan ZEOD and the front-wheel drive GT-R LM NISMO. But there's no gimmick here. The Camaro isn't powered by a fuel cell, driven autonomously or made from antimatter. Instead, it has the more straightforward aim of showcasing NASCAR to an international audience, and maybe recapturing a little bit of that magic that it brought in 1976. That's not to say it's all been plain sailing.

Although the fundamental design ethos is very much taken from the existing Next Gen NASCAR template, this is still a comprehensive overhaul: the downforce has doubled; the weight has been slashed by more than 500 pounds (227 kg); the tyres have been specially developed for the task; and the engine performance is effectively unrestricted. And then, of course, there's the sheer challenge of racing flat-out for 24 hours.

"Bill France Sr always dreamed of bringing NASCAR together with Le Mans. Coming back to Europe to do that again has certainly been a big priority for Jim France [Bill's son and NASCAR's current CEO], so I

think we all feel the pressure to run the full event," admits NASCAR's vice president of vehicle design, Brandon Thomas.

"In a sense, we're only competing with ourselves, which maybe makes it worse. Whatever pressures or expectations we feel come purely from ourselves. We really want to showcase that this car can also be an endurance machine. It runs ovals, it runs road courses, it runs street circuits and dirt tracks, but it can also run a world class endurance race."

Borrowed from GT3

Jim France was one of the key architects of the IMSA/ACO 'Convergence' in top-level sportscar racing. Don't expect anything like that between NASCAR and the GTE class at Le Mans or the GT3 class that will replace it next year, however. They're simply too different, Thomas points out.

"The fundamental premise behind GTE or GT3 is to take a body-in-white production car and adapt it for racing. That, by and large, doesn't work for us," he says. "The car-to-car and car-to-wall proximity that we have at very high speeds on the ovals would totally preclude that format to us. On the other hand, there are things that we've learnt from GT Daytona [IMSA's equivalent of GT3]. We borrowed a lot of durability cycles and things like that. And we flat out stole the carbon fibre propshaft out of the Lexus RC F GT3 – Toyota was kind enough to show us right to their supplier, so it's the same design in the Le Mans car."

In the pioneering spirit of Garage 56, the only real constraint stipulated by the ACO was that the car should be capable of lapping at roughly the same pace as the GTE entries. The rest was largely up to NASCAR, but the engineers were on a self-imposed target to retain the core design philosophy as much as possible.

"We came across a lot of things that were specific to that stock car DNA," comments Thomas. "One of the first things our aero group did was to simulate the car with a ▶

GOODYEAR
2023
GARAGE 56
NASCAR TO LE MANS
CHEVROLET
NASCAR
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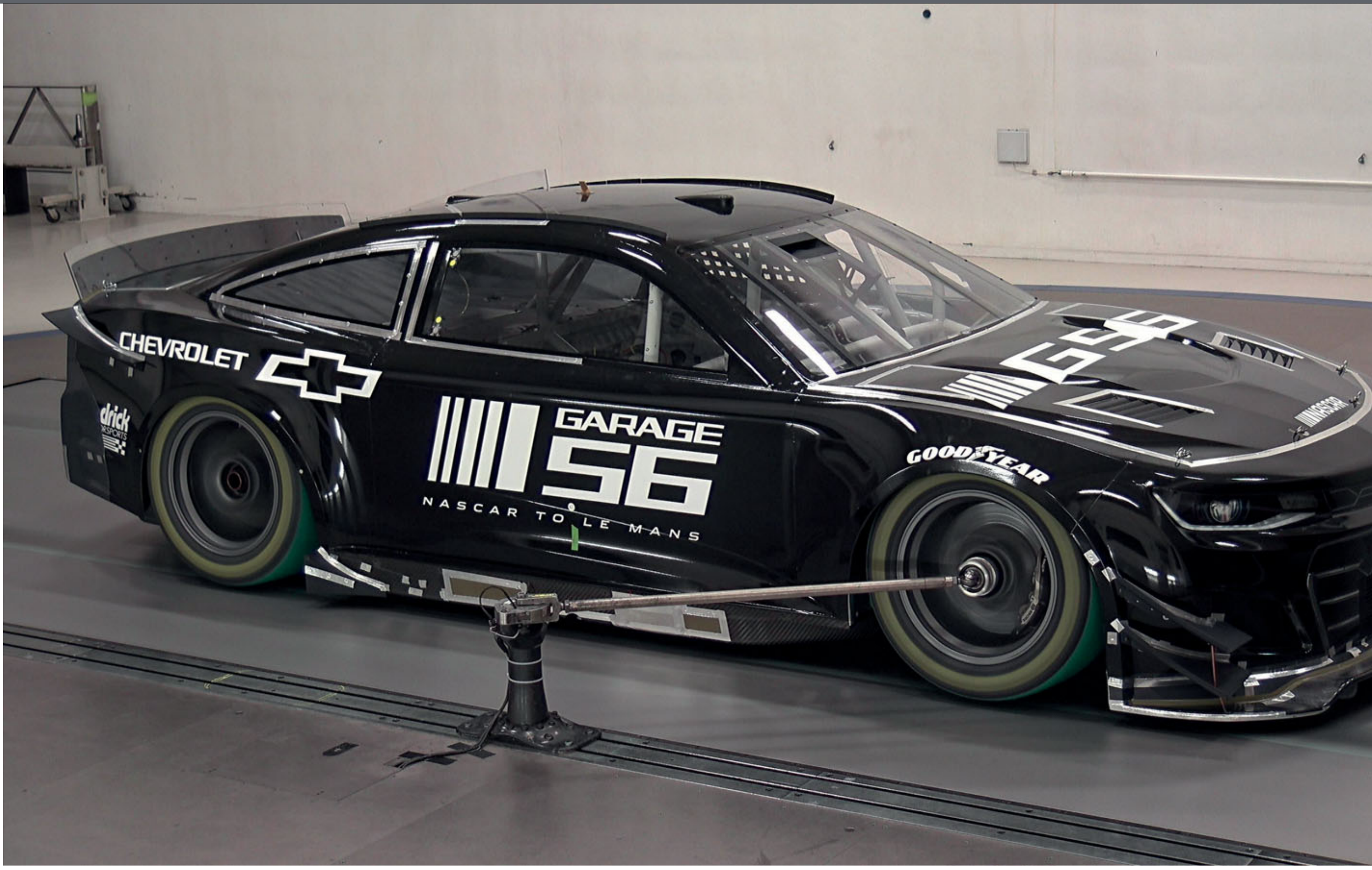
BELOW The headlights are a first for NASCAR but some of the other discoveries during the project are likely to filter back into the regular Cup mount

Photos: Getty Images/NASCAR



rear wing, and right off the bat, Jim France said 'no rear wing, we're going to stick with a [stock car-style] spoiler'. And we instantly understood the logic. Similarly, with the engines, we toyed around with a couple of other options from the world of IMSA, but then realised, 'Nope, we're going to run the Chevrolet R07 engine from the Cup car'. We wanted to make sure it was still a Cup car, not a GTE car."

Work on the Garage 56 car stretches back more than three years. Back in February 2020, just before the COVID pandemic struck, NASCAR was readying the third phase (P3) prototype of the Next Gen Cup car for testing. After that, a second P3 prototype was commissioned to be built externally by the Action Express sportscar team.

The purpose of that was to let an outside entity buy all the parts and build the car so they could report independently back to NASCAR. By August of that year, the Action Express car was testing on the Daytona infield road course that the Cup series had visited the day before. One of the advantages of using this circuit was that the engineers knew exactly what lap time to expect from a GTD car, which laid down a good yardstick for the Next Gen prototype.

"We knew we were, let's say, five seconds, off a GTD car at that point in time. So then that kicked-off a lot of discussions. Jim would periodically come back and ask, 'Well, what can we do to get closer to those lap times?' And then finally, he kind of revealed a bit of his motivation to do that. So, the start was then sitting down with myself, Eric Jacuzzi our vice president of vehicle performance – who was head of aero at the time – and our counterparts at Dallara, Luca Pignacca and Alex Timmermans. We sat down and started laying out the restrictions to our lap times."

The physics was straightforward. Cup cars are built to survive high-speed impacts on banked ovals, but they still need to be comparatively affordable to build, which results in an all-up weight including the driver of circa 3,500 lb (1,590 kg). In comparison, a GTD car in the same trim might tip the scales at 2,700 to 2,800 lb (1,225 to 1,270 kg).

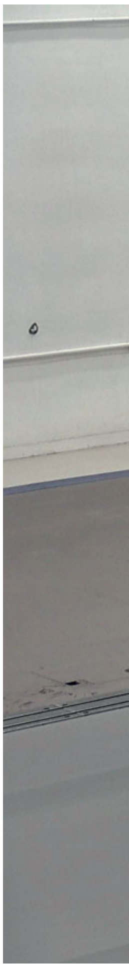
Alongside vehicle mass, the other three main factors were aerodynamic performance, tyre specification and power output. Lap simulations were used to examine the sensitivities to all four of these, giving an idea of the team's priorities.

On the aero side, Dr Eric Jacuzzi and his team found they were able to claw back massive amounts of downforce without doing anything too drastic to the Camaro body shape. The length of the car has grown by around two inches (51 mm) – largely due to a more prominent front splitter, which was redesigned quite radically, and now features a set of turning vanes; the engine panel and the rockers in the floor have been redesigned to feed the diffuser more effectively; and then a smattering of strakes and diveplanes were added to the rear quarter panels, which went through a series of design iterations. The end result is that the downforce is now comparable to a GTE car. In fact, it's thought to be slightly higher.

Crash diet

One of the first priorities with the chassis was to relocate the fuel tank. Cup cars have their fuel tanks housed in a steel box that's slung right over the back, beyond the transaxle. The pronounced shift in weight distribution this creates as the fuel load changes is a deliberate part of the challenge of driving one of these machines.

For the FIA and ACO regulations, however, the tank needed to be placed near the centre within the roll cage, so it now sits



LEFT & BELOW
The tech team have clawed back massive amounts of downforce through the development of the aero package, which includes a radical front splitter

in a carbon fibre enclosure behind the driver. It's also grown from the standard 20-gallon (76-litre) capacity to 32 gallons (121 litres) in order to quench the 5.8-litre cast iron Chevrolet Small Block V8's thirst over a full stint at Le Mans.

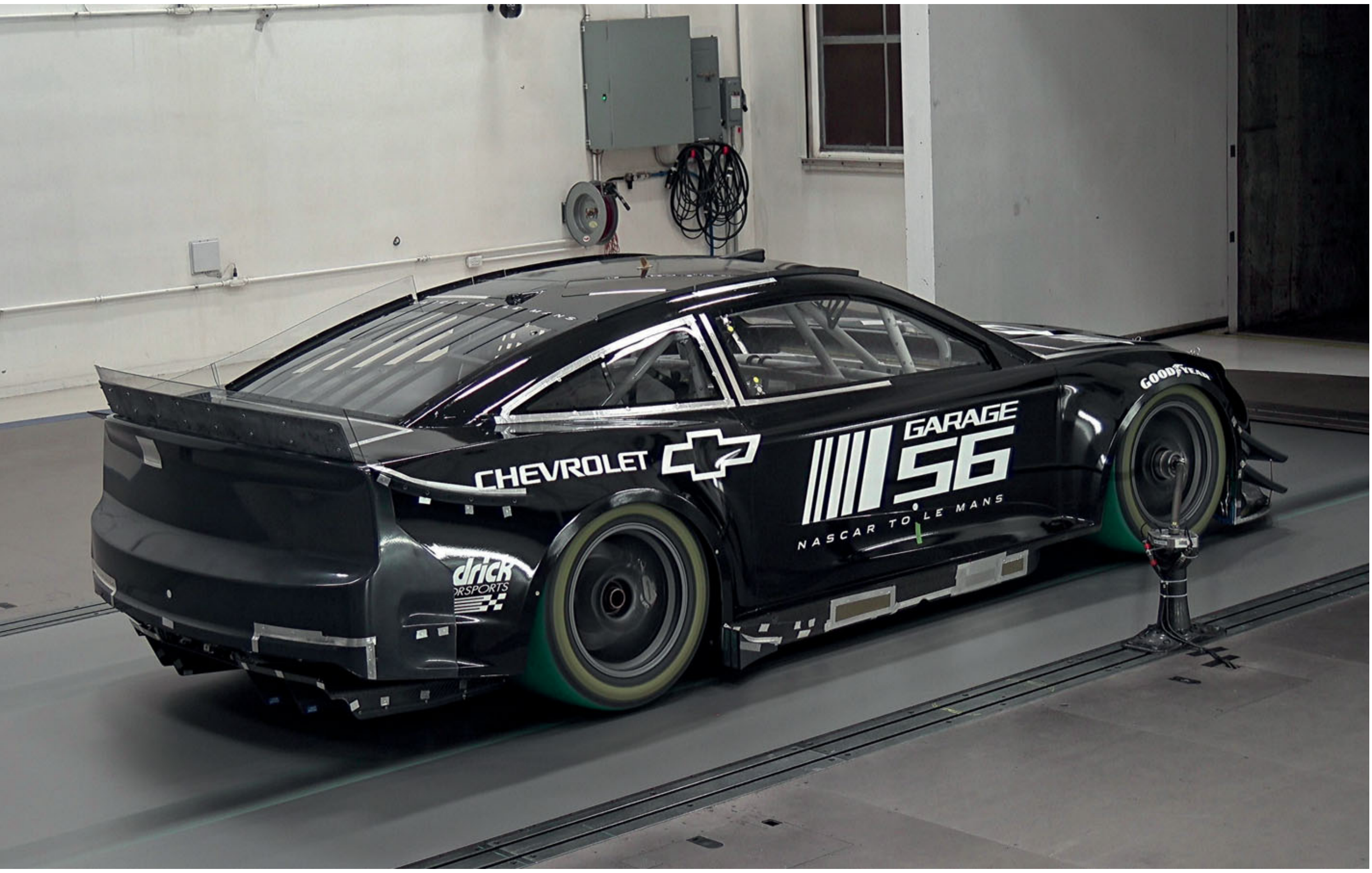
In total, nearly a quarter of a tonne of weight has been shed from the car. The chassis still follows the same tubular design, but the size of the tubes has been reduced in some areas and the steel sheets that make up the anti-intrusion panels and the front and rear firewalls have been replaced with carbon fibre.

"We did back-to-back drop tower testing with those panels to make sure we were still in a good place with regards to safety," notes Thomas. "It's still exactly the same roll cage that you'd find in a standard Cup car and the same overall design, but we've been able to make lots of topographical changes. On the standard chassis, for instance, the fuel cell at the back is heavily shielded against things like control arm fractures, but now that lives in the middle of the car we could cut a lot of steel out of the rear clip. That was a triple-digit weight saving with that one change."

Another easy win, at least on paper, was the decision to broaden the tyres, which now sit half an inch (13 mm) wider at the front and a full one and a half inches (38.1 mm) wider at the back. However, a full development programme has gone into optimising the new slicks and wets, Thomas explains.

> *"Downforce has doubled; weight has been slashed; tyres have been specially developed; and engine performance is effectively unrestricted"*

"We knew that tyre degradation was going to be a big issue – particularly on the rear," he says. "It's a heavy car, and in order to turn the lap time, we're going to be turning the engine up all the way. All of our testing to date has been pretty heavily focused on the tyres. We did a 24-hour test at Sebring, where we ran through five or six unique combinations of dry tyre with all four drivers in different ambient conditions, and it wasn't really until then that we started to figure out which was going to be our primary selection." ▶



Formidable challenge

All of this, it's worth pointing out, has been a side project for the NASCAR engineers, whose day job has been developing and managing the Next Gen Cup car in its first competitive season – the series' biggest technological leap in half a century, and certainly not without its own challenges. Against that backdrop, the scale of the Garage 56 project is not to be underestimated.

"We've had a really great working relationship with Pierre Fillon and Thierry Bouvet and the rest of the team at the ACO. Our main guideline from them was that the car had to be up with the GTE lap times around a lap of Le Mans," notes Thomas. "You get to somewhere like the Porsche Curves and those are really fast turns. We race the Cup car on road courses quite a bit, but if you compare its times to an IMSA race at one of the circuits we both visit – COTA is a good example – it's not just the GTLM cars, the GTD cars are significantly quicker too."

All this hard work appears to have paid off, though. Le Mans star Mike Rockenfeller, who's lined up to drive the Garage 56 car alongside seven-times Cup Series champion Jimmie Johnson and ex-Formula 1 World Champion Jenson Button, drove the Next Gen car in P3 prototype form at VIR in 2020. Returning in October 2022 with the Garage 56 car, he was nearly 10 seconds a lap quicker.

GOODYEAR
CHEVROLET
J. BUTTON
J. JOHNSON
M. ROCKENFELLER

Optimisation

Behind the headline-grabbing changes like the weight reduction and the downforce increase, there's also been a lot of component optimisation. When Thomas and his counterparts at Dallara sat down with brake supplier AP Racing, for instance, it was immediately identified that another significant weight saving could come from swapping the cast iron discs for a carbon-carbon setup.

"That sounds pretty easy until you recognise the mass of the car, the cooling restrictions on the Cup car and the brake energy you're going to actually have to consume per lap," notes Thomas. "The brake ▶

ABOVE & BELOW NASCAR has assembled a dream team of Hendrick Motorsports, Chevrolet, Goodyear and an all-star cast of drivers

NASCAR
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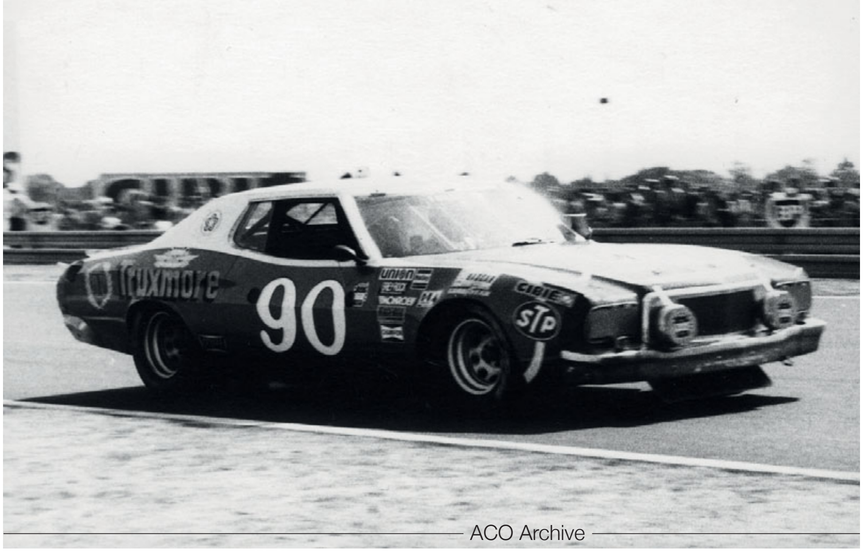


ACO Archive

ABOVE Unfinished business: neither NASCAR completed the 1976 race, although the Ford Torino did soldier on for 11 hours

system required AP to produce the largest and thickest motorsport disc they've ever produced in carbon. It shares its blank with a road-going Bugatti hypercar."

The mass flow of cooling air into the front discs is up by a factor of three compared to the Cup car, he explains. This starts with the suspension uprights, which have been specially machined to allow cooling air to pass through them. Each disc is a massive 40 mm in thickness, with a titanium bell featuring cooling veins that provide blowing on both the front and rear faces.

A lot of thermal simulation went into the design of the brake package, which was tested on AP Racing's dyno in the UK before the first parts were flown out to Sebring for a test just before Christmas.

"I won't say it's bulletproof, because nothing on a racecar is ever bulletproof, but it's certainly gone beyond our expectations," comments Thomas. "The wear rates are very good and the temperature ranges are right in the sweet spot for the carbon front and rear. So hats off to everybody at AP and Dallara on that side of the project."

> *"Goodyear has thrown probably five to 10 years' worth of tyre development at Garage 56 in the last year-and-a-half"*

Another important upgrade is the gearshift system. In standard form, Cup cars deliberately shun any form of driver aid; the Next Gen car may have ditched the traditional four-speed H-pattern gearbox in favour of a five-speed sequential, but it remains resolutely manual. For the Garage 56 car, however, Xtrac has engineered an electronic shift system that fits directly onto the standard gearbox. There's also a Bosch ECU complete with traction control, a power distribution module and marshalling system, along with a Marelli incident data recorder (IDR).

"This car has miles of wiring harnesses on it that a normal Cup car doesn't have," comments Thomas. "The headlights, as well, have been quite a challenge. Dallara jumped in and did the headlight and taillight design for us. That's something I've never worked on in my entire motorsport career. I've worked on stock cars, Champ Cars and IndyCars, and none of those have headlights."

Back in the Cup series, the headlights will continue to be stickers, but there are definitely elements of the Garage 56 car that the series can learn from, Thomas explains.

"We've already experimented a bit with the floor changes from the Garage 56 car," he says. "We ran six Cup cars with the current short track aero package at Phoenix back in January, and the drivers weren't super happy with what we ended up with, so that could certainly inform future changes."

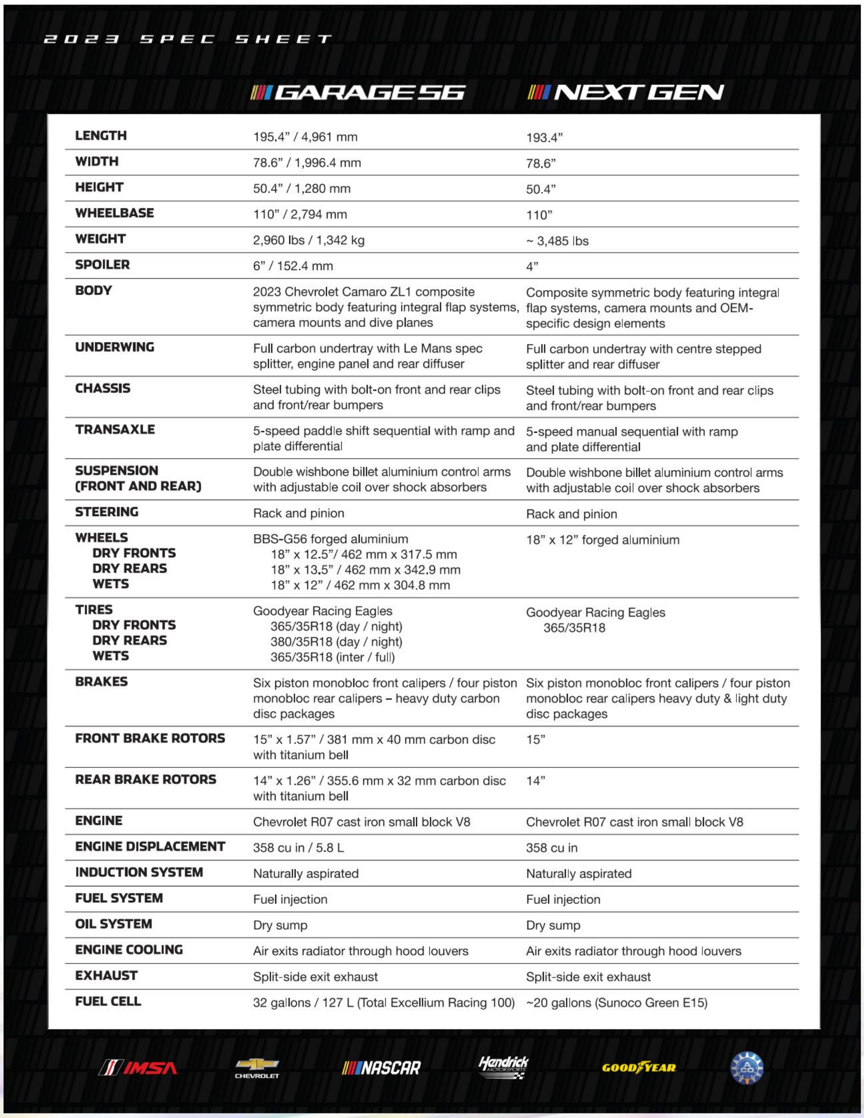
The tyres are another area where standard Cup cars are likely to benefit in the future, we're told: "Goodyear has thrown, I would say, probably five to 10 years' worth of tyre development at Garage 56 in the last year-and-a-half, based on the number of mould shapes, sizes, compounds and constructions they've tried across dry, wet and intermediate tyres."

Bringing the noise

For NASCAR's in-house engineers in particular, Garage 56 has been a special project. "Our R&D team here is pretty small – we do a lot of work with Dallara on the design side – so this was a really interesting chance for us to go after a big project where the aim was to get as much performance out of the car as possible," he says. "Put a standard Cup car on the grid at Le Mans and, honestly, you'd probably be seven to 10 seconds a lap off the pace of a GTE car, so it was a big task."

The achievement won't be complete until the car takes the chequered flag, he admits: "Gary Nelson from Action Express has this expression that he beats into our heads, which is 'keep the wheels turning', which is kind of profound. It's all about keeping the car going. Right from the start, a lot of people questioned whether this car was built for endurance and whether it could make it. But we started at the design phase, with higher mileage limits on the components for that reason. The wheel bearings, for instance, are spec'd to run for 10,000 miles, and doing that on some of

RIGHT Such is the rate of progress that the Garage 56 car is now nearly 10 seconds a lap quicker than the Next Gen prototype tested by Mike Rockenfeller back in 2020



2023 SPEC SHEET

	GARAGE 56	NEXT GEN
LENGTH	195.4" / 4,961 mm	193.4"
WIDTH	78.6" / 1,996.4 mm	78.6"
HEIGHT	50.4" / 1,280 mm	50.4"
WHEELBASE	110" / 2,794 mm	110"
WEIGHT	2,960 lbs / 1,342 kg	~ 3,485 lbs
SPOILER	6" / 152.4 mm	4"
BODY	2023 Chevrolet Camaro ZL1 composite symmetric body featuring integral flap systems, camera mounts and dive planes	Composite symmetric body featuring integral flap systems, camera mounts and OEM-specific design elements
UNDERWING	Full carbon undertray with Le Mans spec splitter, engine panel and rear diffuser	Full carbon undertray with centre stepped splitter and rear diffuser
CHASSIS	Steel tubing with bolt-on front and rear clips and front/rear bumpers	Steel tubing with bolt-on front and rear clips and front/rear bumpers
TRANSAXLE	5-speed paddle shift sequential with ramp and plate differential	5-speed manual sequential with ramp and plate differential
SUSPENSION (FRONT AND REAR)	Double wishbone billet aluminium control arms with adjustable coil over shock absorbers	Double wishbone billet aluminium control arms with adjustable coil over shock absorbers
STEERING	Rack and pinion	Rack and pinion
WHEELS **DRY FRONTS** **DRY REARS** **WETS**	BBS-G56 forged aluminium 18" x 12.5"/ 462 mm x 317.5 mm 18" x 13.5" / 462 mm x 342.9 mm 18" x 12" / 462 mm x 304.8 mm	18" x 12" forged aluminium
TIRES **DRY FRONTS** **DRY REARS** **WETS**	Goodyear Racing Eagles 365/35R18 (day / night) 380/35R18 (day / night) 365/35R18 (inter / full)	Goodyear Racing Eagles 365/35R18
BRAKES	Six piston monobloc front calipers / four piston monobloc rear calipers – heavy duty carbon disc packages	Six piston monobloc front calipers / four piston monobloc rear calipers heavy duty & light duty disc packages
FRONT BRAKE ROTORS	15" x 1.57" / 381 mm x 40 mm carbon disc with titanium bell	15"
REAR BRAKE ROTORS	14" x 1.26" / 355.6 mm x 32 mm carbon disc with titanium bell	14"
ENGINE	Chevrolet R07 cast iron small block V8	Chevrolet R07 cast iron small block V8
ENGINE DISPLACEMENT	358 cu in / 5.8 L	358 cu in
INDUCTION SYSTEM	Naturally aspirated	Naturally aspirated
FUEL SYSTEM	Fuel injection	Fuel injection
OIL SYSTEM	Dry sump	Dry sump
ENGINE COOLING	Air exits radiator through hood louvers	Air exits radiator through hood louvers
EXHAUST	Split-side exit exhaust	Split-side exit exhaust
FUEL CELL	32 gallons / 127 L (Total Excellium Racing 100)	~20 gallons (Sunoco Green E15)

the tracks we visit would melt a typical set of motorsport wheel bearings."

For all this preparation, Thomas says he anticipates further challenges once the team gets to Le Mans, but he's hopeful that they can put on a show to remember. During the development, NASCAR has done a fair amount of testing alongside the Corvette GT3 and GTE cars. Even compared to what's traditionally been one of the more raucous GT cars, he promises that the Garage 56 machine will stand out.

"I can't wait to see the Ferraris, Porsches, Astons and Corvettes lined up and then here comes their redneck American cousins in their big Camaro," he jokes. "It's going to be quite the spectacle, and you'll certainly hear us coming."

As the event's centenary year and the first big showdown of the LMH/LMDh era, Le Mans 2023 promises to be a classic. But just as in 1976 – when, incidentally, Jacky Ickx and Gijs van Lennep cruised to a comfortable victory in their Porsche 936, a full 11 laps ahead of the competition – don't be surprised if it's the NASCAR contingent that steals the show. RT

GARAGE 56
CHEVROLET
GOODYEAR

ABOVE The spectacular setting of the Dakar Rally showcased the strengths of sustainable fuel as a powerful and credible technology in our bid to reduce greenhouse gasses

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HISTORY *NOT* MYSTERY

With an unprecedented run of six successive stage wins, Sébastien Loeb's feats on this year's Dakar Rally shone a light on the benefits sustainable fuels can deliver, not just in motorsports but for the entire ICE fleet. By **Chris Pickering**

It may have missed out on the top step of the podium, but the Prodrive Hunter T1+ certainly made a statement at this year's Dakar Rally. Sébastien Loeb and co-driver Fabian Lurquin captured a record-breaking six consecutive stage victories on the event. In total, the pair won half of all the stages in the two-week desert marathon. And they did it all with a fuel that slashes CO2 emissions by a massive 80 per cent.

The arguments for and against sustainable fuels in motorsport can be complex – certainly when you have major OEMs with battery electric road cars to promote and relatively short sprint races to contest. When you're racing for 600 km at a time over the desert, however, things become a whole lot more straightforward. For events like the Dakar to continue with their current format, we're going to need energy-dense liquid fuels for the foreseeable future. And quite possibly forever.

Agricultural waste

Before we delve into the bigger picture surrounding sustainable fuels, it's worth having a quick recap on some of the processes used to create them. In the case of the Prodrive EcoPower blend, developed by Coryton Advanced Fuels under its new SUSTAIN Racing banner, the two key components are bioethanol and e-fuel.

Around 71 per cent of the fuel is derived from bioethanol. This starts with agricultural waste such as starch slurries and the stalks from corn harvesting. These are fermented to produce ethanol, which is then passed through a two-stage catalytic process, which breaks the alcohol down into carbon, hydrogen and oxygen, and then reforms it into a broad-range hydrocarbon (the oxygen being released as a byproduct).

"To all intents and purposes, it looks just like a normal fossil gasoline, it's just that you've not used a fossil feedstock to get there," notes David Richardson, business development director at Coryton. "The good thing about that particular process is that it actually requires very little energy. The plants that we use are attached to other industries, and they can harness the waste heat from those industries to help the fermentation process.

> *"Sustainable gasoline is the most mature low-carbon technology here and now"*

"One of them, for instance, is attached to a bakery, so they use the leftover yeast as the feedstock and take heat from ▶

the bakery. This fermentation process releases CO2, which is then captured and used for the drinks industry."

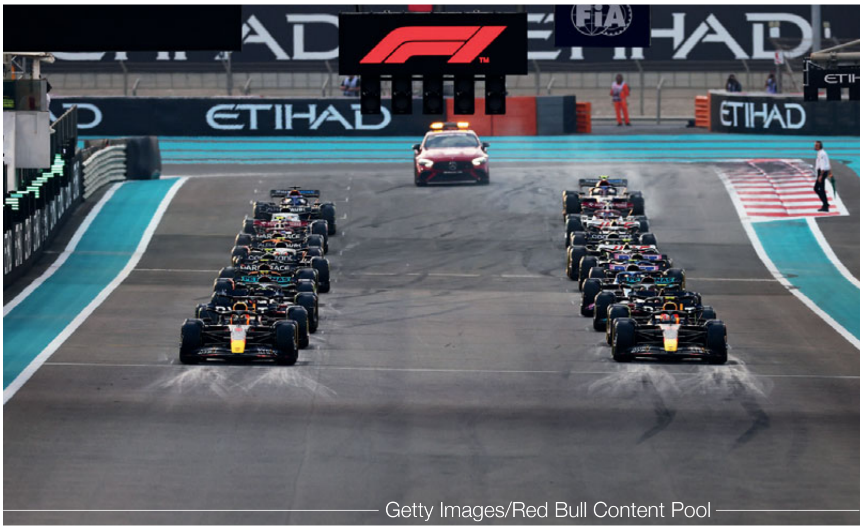
The catalytic process that follows is exothermic, so the heat is recovered and used to power the plant. In theory, it actually means the process could be carbon negative, Richardson points out, although there's currently a small net emission of greenhouse gases.

"At present, agricultural byproducts like corn waste are often ploughed back into the soil. This can lower the quality of the soil and release methane when it decomposes, so there's a real benefit if you can take it away for something useful instead," he notes.

The e-fuel side of the equation begins with CO2 – either taken as a byproduct from other industrial processes or captured direct from the atmosphere. Meanwhile, water is electrolysed to capture hydrogen and oxygen. Both processes are energy intensive, but they need to be taken in context, Richardson explains.

"The whole concept of these plants is that they are built off-grid where it would be hard to export the energy," he comments. "The easiest way to transport this energy that's been captured by wind, by solar, by geothermal or whatever means is to store it in a liquid."

Once the carbon and hydrogen have been extracted, they are put through a similar process to the bioethanol-derived components to produce hydrocarbons. It is, in effect, replacing the fossil chemistry set with a sustainable alternative.



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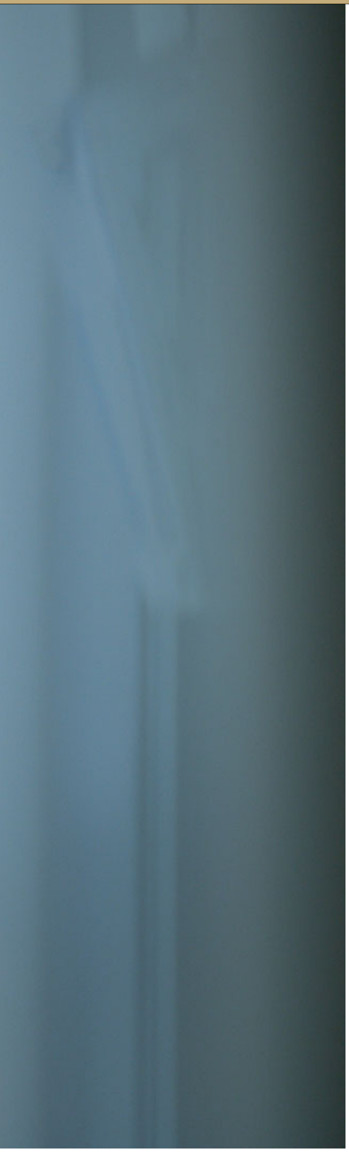

LEFT The bespoke blends created in the Coryton laboratory are playing an increasingly influential role in the wider debate over sustainable fuels

Hydrogen alternative

The key selling point of low-carbon gasoline blends is that they can be engineered to work with a completely unmodified combustion engine. But, in theory, a revised engine based around the same architecture could be made to run on hydrogen, which would eliminate the additional financial and environmental cost of processing the gas into a more complex hydrocarbon. These savings could be substantial, and the tailpipe emissions from hydrogen combustion are lower than that of synthetic gasoline, so why bother with the additional processing?

"There are definitely benefits to using hydrogen, but there are also some significant downsides," comments Richardson. "Aside from capturing the gas in the first place, the next big challenge is transporting it. In order for hydrogen to be usable it needs to be compressed to around 250 bar, which is a phenomenal pressure, and typically involves tanks made of carbon fibre if you want to keep the weight down. Even then, the tanks occupy three or four times the volume of the equivalent gasoline storage."

Another challenge is the infrastructure. Richardson points out that the operating pressure of natural gas pipelines is far too low for these to be adapted for hydrogen, which means that mass adoption would require a whole new network. There is, of course, an ▶

> *"Ethanol is going to be a fundamental component in fuel design going forwards"*

CORYTON
SUSTAIN
BY CORYTON

RIGHT Coryton produces sustainable fuel under the brand SUSTAIN

LEFT Should Formula 1's transition to sustainable fuel for 2026 be performed in stages?

environmental cost associated with establishing this new infrastructure too. In contrast, he notes, just about any fuel that's liquid at normal ambient temperatures can be stored and transported with the existing facilities.

"Generally, what you tend to see is people using hydrogen in heavy-duty industries or marine applications, where they've got a captive infrastructure," comments Richardson. "For instance, ships and heavy goods vehicles tend to be based at a fixed location and then return to that port or that depot, where they can fill up. Once you're talking about large marine vessels you could, in theory, even create the hydrogen onboard."

Bright future

The Dakar Rally has set a target to have all elite competitors using low-emissions technologies by 2026. Meanwhile, Formula 1 is aiming to introduce fully sustainable fuels the same year.

Richardson admits it's a tricky balance for the manufacturers: "There's often a worry that if a team introduces something new, it could go wrong and they could lose a lot of money and credibility. On the other hand, if they don't embrace that, there's a danger that it could be thrust upon them at a later date without any preparation."

> *"Replacing the fossil chemistry set with a sustainable alternative"*

Instead, he suggests, the best approach is to take it gradually and build up experience: "A few years ago people were doing some very interesting work on sustainable fuels in F1, but then they were limited to just having ethanol in an E10 blend (10 per cent bioethanol), which is all they will have until it suddenly switches to 100 per cent sustainable in 2026. Personally, I think they would have been better off with a phased introduction, gradually increasing the sustainable content over three or four years."

Understandably, the most frequent questions from potential customers centre on cost and availability. In theory, Richardson explains, there's already the capacity to produce tens of millions of litres per year, which would easily satisfy the requirements of motorsport, and more is coming. Porsche's Haru Oni e-fuel plant in Chile is now online and targeting 550 million litres in two years' time, while Aramco and ▶

BELOW Coryton has recently launched SUSTAIN, a new sustainable fuels offering

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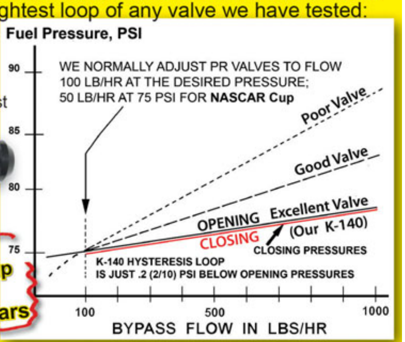

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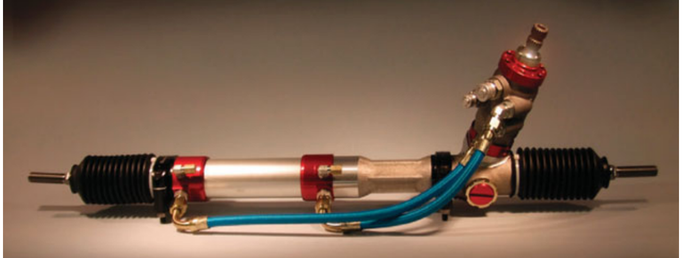

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ABOVE The specialist recently worked with Mazda to establish a new lap record for a sustainable-fuelled car at racetracks in each of the UK home nations

Repsol are working on a pilot plant that should be producing 2.6 million litres a year from 2024.

Cost remains an issue, but Richardson believes it's one that's overstated – at least where big budget professional teams are involved.

"The cost of fuel in motorsport is a very small part of the overall package throughout the year, but it's a matter of perception" he comments. "A team might go from paying €3 or €4 per litre for existing motorsport fuel to, say, €6 or €7. That's maybe €10,000 a year more, which sounds like a lot, but it's actually just one per cent of a €1 million annual budget. And look at what you get for it. We know that some sponsors don't want to be associated with people burning fossil fuels, so this is an opportunity to do something proactive."

> *"The key selling point of low-carbon gasoline blends is that they can be engineered to work with a completely unmodified combustion engine"*

Data gathering

Chemically, the fuel that Coryton supplied to the Prodrive teams for this year's Dakar was unchanged from its debut in 2022. Instead, the focus was on continuing to gather data and promoting the discussion around sustainable fuels.

Prodrive and Coryton tested the fuel extensively during its development in 2021. Although essentially a drop-in substitute, a number of minor tweaks were made to optimise the Hunter's 3.5-litre twin-turbo Ford V6. The alcohol content, for instance, reduces the air-to-fuel ratio slightly so the fuel flow rates were increased marginally to compensate (although it still runs at the same lambda value).

Numerous checks were also carried out to ensure reliability. In-cylinder pressure measurements were used at the beginning of the project to rule out any risks of pre-ignition or detonation. Meanwhile, oil dilution was monitored, along with any signs of chemical corrosion from the alcohol content of the fuel. An engine was also tested on the dyno to make sure that the sustainable blend could match the indicated mean effective pressure (IMEP), brake specific fuel consumption (BSFC) given by the FIA's 102 RON reference fuel.

Skip back to this year, and the long-term ▶

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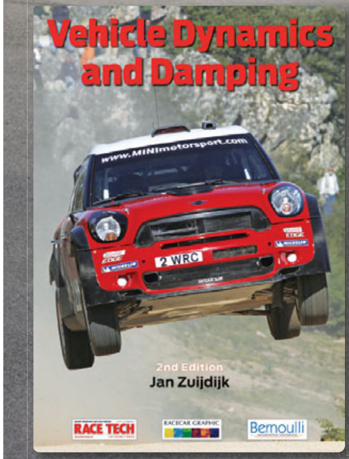

BY JAN ZUIJDIJK

The follow-up to Jan Zuijdijk's original book that has been edited by William Kimberley, editor of RACE TECH magazine.

The author, who has been involved with suspension design and development for race and high-performance road cars for more than 40 years, writes about the evolution of suspension systems over the decades. However, this is more than just an historical book but a very practical one that will help the driver and vehicle dynamics engineer set the car up in the best possible way.

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observations continue. "It's a question of keeping in touch with the powertrain engineers so they can relay back anything we might need to monitor or change," comments Richardson.

"There are things the industry needs to be ready for – a clear example of this is that it can have an impact on various parts of the fuel system if you're using high levels of ethanol. In Formula 1, the FIA is actually going to mandate a minimum amount of ethanol for 2026 onwards, so we think it's going to be a fundamental component in fuel design going forwards. A lot of the data we're gathering at the moment from programmes like the Dakar are more about helping the rest of the industry to prepare for it being mandated in the future."

ABOVE & BELOW Using a bespoke blend of sustainable fuel from Coryton, Bahrain Raid Xtreme (BRX)'s Sébastien Loeb and Fabian Lurquin staged a record-breaking fightback to finish second

> *"Some sponsors don't want to be associated with people burning fossil fuels"*

Ethanol does have its advantages – notably charge cooling and knock resistance – but it's entirely possible to produce a fuel without using any alcohol at all.

"The fuel that we've supplied to Prodrive does use a fairly significant amount of ethanol, but we've got others that we're developing for applications like historic vehicles that don't have any at all," notes Richardson. "Another thing to bear in mind is that we start the process with ethanol as one of the building blocks, but once we remove the oxygen molecule it's no longer ethanol, and it no longer has those properties. So a fuel that's derived from bioethanol is not necessarily any different to a fossil-derived fuel once it's been processed."

Formula Student partnership

It doesn't even have to start with ethanol. Methanol can be produced as an e-fuel or by processing methane captured from sources such as agricultural slurry. Methanol can also be used to create methyl tert-butyl ether (MTBE) – a common fuel additive that can be used to improve qualities such as knock resistance.

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ABOVE Coryton is one of the leading authorities on sustainable fuel, helping raise its profile in the transport sector

The work with Prodrive is one of a number of motorsport projects for Coryton. Another that's recently been announced is the firm's partnership with Formula Student, which will see the competition offering a fully-sustainable E10 blend this year.

Coryton's projects are just part of a growing shift towards sustainable fuels. Elsewhere, the FIA Formula 2 and Formula 3 championships are among those switching over to fully sustainable fuels this year, following on from the World Rally Championship's successful transition in 2022. All remaining FIA championships are due to switch by 2026.

The debate as to whether sustainably-produced gasoline offers a better long-term solution than rival technologies such as hydrogen combustion, fuel cells or battery electric storage will no doubt rage on. In some cases, the solution will depend on the concept's relevance to road cars, which have differing requirements to those on the track. But what's clear is that sustainable gasoline is the most mature low-carbon technology here and now – at least for long-distance events where high energy densities are required – and one that the racing world could adopt with minimal effort. RT

LIFE IN THE FAST LANE: FROM COFFEE MACHINES TO FORMULA 1

A remarkable journey has culminated in the development of a new high-frequency ultrasonic flow sensor for motorsport. **Craig Scarborough** reveals how a family's brave risk has been rewarded

COMING from a background in hot water heating systems and coffee machines, Allengra GmbH isn't exactly the typical motorsport supplier. But its expertise in ultrasonic flow sensors matches closely with the FIA's demand for monitoring fuel flow. By taking a risk with a tender for the supply of fuel flow meters, the company has – rather than landing in hot water – found a warm welcome and new markets.

Looking at suppliers in F1 and motorsport in general, the industry is well supported by small companies that specialise in designing, developing and supplying solely into the sport. Allengra, however, is far from the typical niche supplier we have come to expect.

"Yes, we get that a lot!" admits Niels Junker, Allengra Flowmeters GmbH Commercial Director, when I express surprise at the shift of industries.

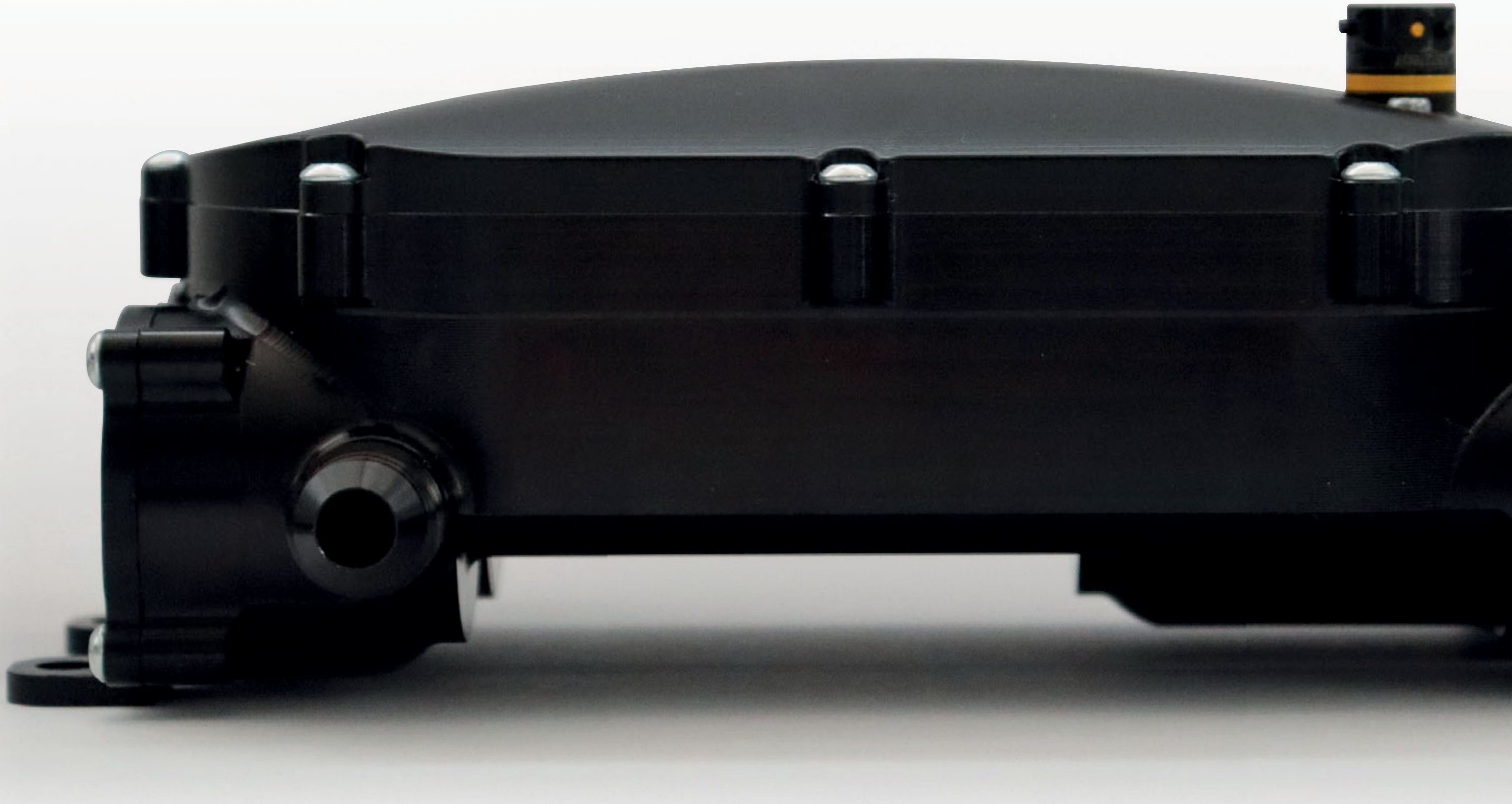
The company may have taken an unusual route to the sport, but its expertise as a manufacturer of ultrasonic sensing solutions to industry is a perfect fit with motorsport's energy revolution.

"My father (Raul Junker) founded the company in 2005. He came from the water meter industry in Germany," explains Niels. "All the water meter companies were focusing on mechanical meters because they're cheap and, let's say, 'good enough'." But not content with the old-fashioned technology, Raul wanted to evolve the industry.

"He's like a born engineer," reflects Niels. "He said, 'I want to do more than something mechanical.' He tried at the company where he worked, suggesting, 'Let's do some ultrasonic metering?' He did some experiments, but his boss didn't support it. Why change a running business?"

Thus the idea of Allengra was born. Raul Junker started his own business, based around ultrasonic sensing. "His dream was just to develop ultrasonic sensors," explains Niels. "But he didn't know what direction it could go, what industries would follow that up."

It transpired that the heating industry



BELOW & RIGHT Allengra's AL-12-0026 Fuel Flow Meter was granted FIA homologation after rigorous testing

was ideal for this technology. "Heating was quite interested, because ultrasonic sensors don't have moving parts or sensitivity to high temperatures in water," says Niels. "The heating water is also quite dirty; for mechanical sensors this is a problem."

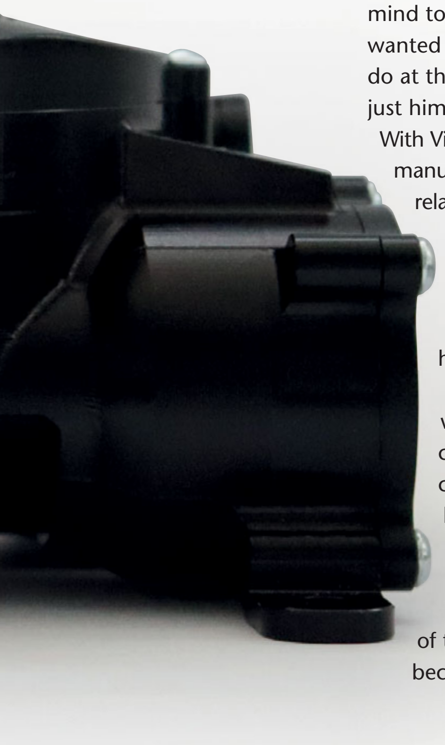
Seizing his opportunity, Raul developed an ultrasonic sensor for boiler company Viessmann. "They were quite interested and he finished his first product for gas burners, but we were measuring the water circuit to increase the heating efficiency in houses," recalls Niels. At this point Raul only had in mind to design the sensor, but Viessmann obviously wanted a supply of it, something he was unable to do at the time, given that the operation consisted of just him and three engineers!

With Viessmann's support, they looked for a manufacturer, but none were interested in a relatively new technology for a domestic product.

Then came the crunch moment: "Viessmann said, 'Okay, you will have to do it!' He said, 'How should I do it? I have no experience whatsoever.' They replied, 'We're going to help you set it up.'"

Manufacturing started in Romania. There were two good reasons for this: production costs in Romania were lower, but it was also the country where both Raul and Niels had been born, albeit the latter grew up in Germany.

Thus the real business of Allengra grew up with supply into the heating market, which expanded as other manufacturers learnt of the technology. Serving this sizeable niche became the company's mode of operation. "We focused on the OEM business, really integrating our ultrasonic technology into the needs of the clients," recalls Niels.



> "We measure time of flight from the sender transducer to the receiver and then back again against the flow"

Next up, the same ultrasonic sensing solution was applied to the food industry and something that has long kept the motorsport sector going: coffee machines!

Here there was again a natural advantage of the ultrasonic tech over mechanical systems. "You can have a more hygienic design," observes Niels. "If you use mechanical ones with the wheel, milk gets in there." Of course, there is a process is to clean the pipework, but according to Niels, there's still an issue: "Even if you put the cleaning agent through, it still just gets stuck; you do not want to enjoy the coffee from those machines!"

Today, he says, the modus operandi remains the same for the company: "We produce 20-30,000 pieces for a client per year; we are focusing on higher numbers than in F1."

Shaking up F1

For all that electrification has dominated the headlines, combustion engines are still very much a part of motorsport. F1 started using a fuel flow meter ▶

> ***We went to a top F1 team to test if the sensor can be manipulated, by changing frequencies. They couldn't cheat our sensor***”

as far back as 2014, with the advent of its hybrid engines, as a way to constrain fuel usage while on track. This means to accurately monitor fuel flow has spread to other categories – either as a regulatory method to measure flow, or as another data feed for the teams.

For F1, a series of tenders have established the exclusive supplier and also homologated the sensor for use in other categories. To date there have only been two suppliers: Gill Sensors and Sentronics, the latter superseding Gill as the F1 spec Fuel Flow Meter (FFM).

Now, thanks to Allengra's efforts, there is a third FIA-homologated sensor, already proven in some of the toughest conditions on the Dakar Rally.

When F1 first introduced an FFM in 2014, cars were limited to an instantaneous fuel flow of 100 kg/hr. The sensor sits inside the fuel tank, in the low-pressure end of the system, to measure flow up to the high-pressure fuel pump. Its data is captured through the ECU and made available to the FIA via the Safety Data Recorder (SDR).

The system wasn't without a few issues in its first races, causing the FIA and Red Bull Racing some concerns. But in the subsequent seasons, the FFM went largely unnoticed. Until 2019, when Ferrari's straightline speed prompted rumblings about it having discovered a work-around to the FFM, allowing greater fuel flow than the meter declared.

It was never officially proved that Ferrari had been cheating, nor that the Scuderia's engine had been fully compliant with the regulations. Instead, a surprise statement, released amid 2020 pre-season testing, said: "The FIA and Scuderia Ferrari have agreed to a number of technical commitments that will improve the monitoring of all Formula 1 Power Units for forthcoming championship seasons as well as assist the FIA in other regulatory duties in Formula 1 and in its research activities on carbon emissions and sustainable fuels."

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RIGHT The flow meters are tested thoroughly in-house

However, subsequent changes to the FFM installation offered us clues as to the potential means of getting round the system: by clipping the meter reading with a fuel pump harmonised to the single FFM's 2 kHz sampling rate.

For 2020 it was mandated that teams had to run two Sentronics FMMs in series: one for the team to gather data from, then another with a different (undisclosed) sampling rate and a secure data connection to the SDR. This latter FIA-only FFM ensured that no team could scan the output and attempt to circumvent its job of measuring fuel flow.

This setup remains in place in F1 through to the next power unit regulation changes in 2026. Allengra plans to tender for this new specification, when the FIA invites manufacturers to submit their applications later this year.

How it works

If we know what the ultrasonic sensor does in terms of producing an accurate output, what's going on inside the housing?

It's surprisingly simple, as Niels Junker explains: "Basically, you have two transducers that are face-to-face. They send an ultrasonic signal from one transducer to another. They are arranged in a way that they are sending the signal through the flow of the medium; it can be liquid or it can be gas."

Then it's down to how the signal interacts with the fluid flow that creates the output. "The flow should accelerate the signal. What we measure is the time of flight, the time from the sender transducer to the receiver and then back again against the flow," he says.

The time difference between these two readings is the flow speed, as the transducers are inside a tube of known diameter, then you can calculate volume. Lastly, a pressure reading enables the sensor to be calibrated for mass flow sensing.

This simple layout means that the sensor can be applied in many different ways, according to Niels. ▶

LEFT The company's ultrasonic fuel flow metering has already been proved in extreme Rally Raid conditions

"You just need the two transducers face-to-face; you could integrate them in many shapes and forms. It's beautiful for many clients: 'This is our application – can you make a sensor that fits into that?'"

So, with a successful business, in stable market industries, why the shift to F1? Especially bearing in mind that the small production volumes are the antithesis to the philosophy of the company.

> *"The short tube works at different frequencies: it's the watchdog checking if something's going on!"*

"That's true," admits Niels. "But my father and I are big F1 fans, since at least 2007. We read that there was an ultrasonic sensor – back then it was Gill – that they used for fuel metering. We thought we were just dreaming! Oh my god, how incredible: they use the same principle as us for F1!"

Still there was no direct link between Allengra, a growing company, and the sport – until fate played a hand. In 2020, by sheer coincidence, Niels was surfing for news on an F1 website. His eye was caught be a story outlining that there was a new tender for a Fuel Flow Meter.

Sensing an opportunity, he went to Raul, his father: "'Look, there's this tender. What about if we do something? He was like, 'No, for sure it's too complex, it's not our domain and we don't have experience.'"

Perhaps Raul was right, but Niels was insistent and persistent: "So, I called him day after day. 'Let's at least try; we have nothing to lose. We'll do a side thing, let's say, as a hobby.'"

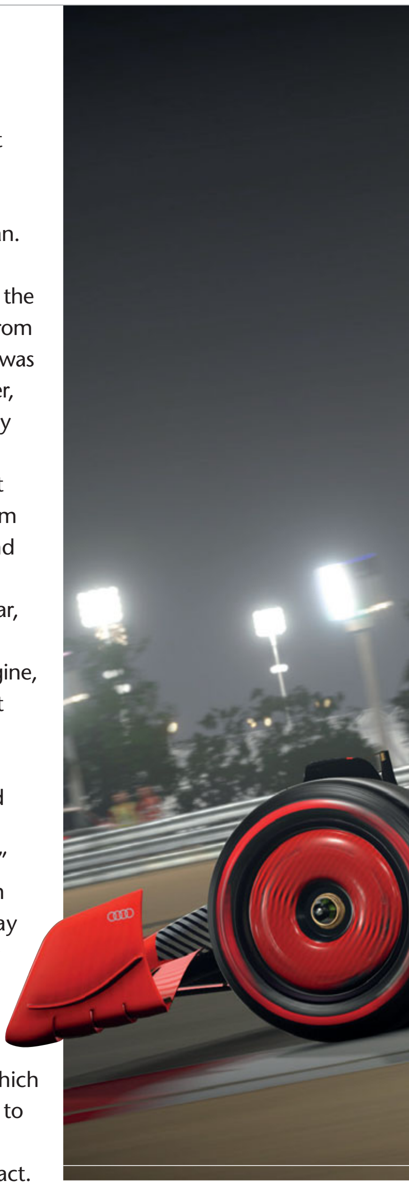
Eventually, Raul relented and the new journey began. They applied in March 2020 for the FIA tender. This initial bid was delayed, as were so many projects, by the pandemic. The attempt elicited a routine response from the FIA, the sport's governing body, that everything was on hold and the tender was put back. But, a day later, they were contacted directly by the FIA, asking if they could investigate the project in more detail.

With the door opened, the team could set about their work. "We started developing the sensor from April 2020, until we had the first version at the end of 2021," notes Niels.

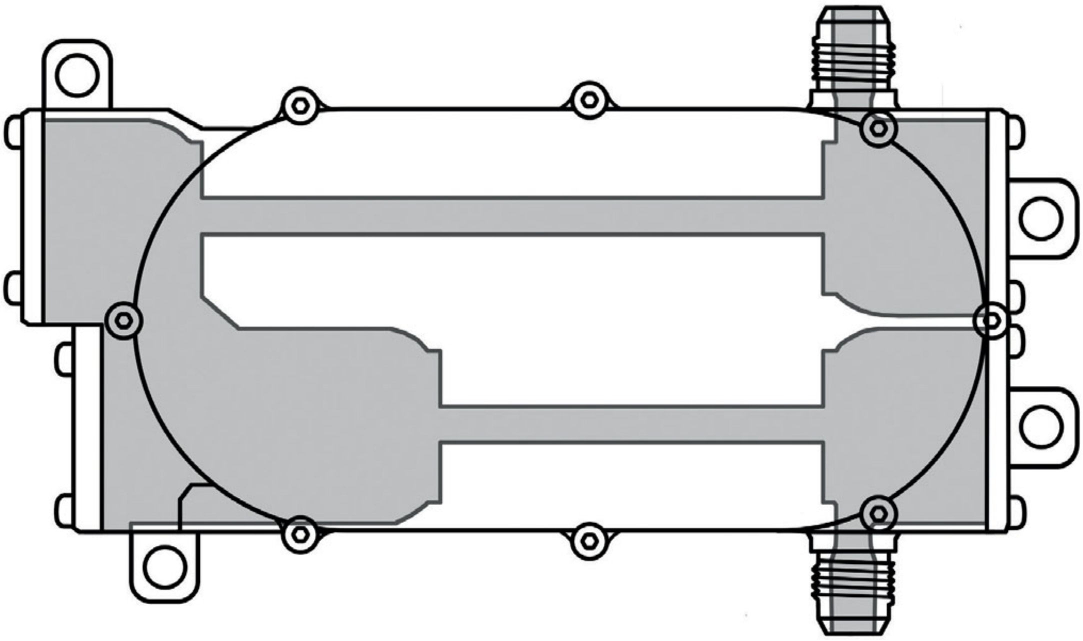
Then, for the traditional start of the motorsport year, the sensors went into action. Not in F1, but at the Dakar Rally. Quite a baptism of fire, you would imagine, having to prove their worth in perhaps the toughest endurance event in the world. Allengra provided two sensors, in two separate cars, in two different categories. By the end of the race, Niels was pleased with the outcome: "They survived the Dakar, we gathered all the data and the FIA were quite happy."

The success earned Allengra the homologation to start its formal business in motorsport. By May 2022, the sensor was officially homologated for use in the World Endurance Championship and its North American counterpart, IMSA.

Yet still the main prize proved elusive. Allengra missed out on the tender for the F1 FFM supply, which would take the homologated power units through to the end of 2025. That was awarded to the present incumbent supplier, Sentronics retaining the contract.



ABOVE Allengra is bidding to supply the Fuel Flow Meter for the next-generation F1 engine, due in 2026, when Audi (pictured), Ford and Porsche enter a category boasting 100 per cent sustainable fuel and greater electrification



LEFT Rather than adopt a double FFM setup, Allengra has opted for a two-tube solution. The short tube works at variable frequencies to prevent cheating

Audi Sport
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If there wasn't a formal explanation, one of the factors undoubtedly at play was the series moving to a budget-capped formula. An all-new FFM would mean a completely reworked setup, to mount the FFM, as well as the fuel and electronics connections – all costs that the teams will have wanted to avoid.

But an opportunity still remains. For 2026 there will be a new set of regulations, including the heavily revised power unit rules, which will require tenders for the supply of a number of power unit homologated parts, including the FFM as well as the ECU.

Undeterred by the first knockback, Niels is still looking forward. "This year there's a new chance to tender for F1 in 2026; we are working on that currently," he reveals. "We are bringing the sensors into different WEC teams, and are curious as to how well they will work. We saw them work in Dakar already and since then we have a new version. I'm confident it will be good."

The sensor that has been awarded the FIA homologation is called the AL-12-0026. This is a distinctly different-looking sensor to the outwardly similar Gill and Sentronics FFMs. Part of the reason for this is the clean pair of eyes the design team brought to the unit's layout. Also, despite using the same basic ultrasonic technology, the AL12 goes about the job in a very different way.

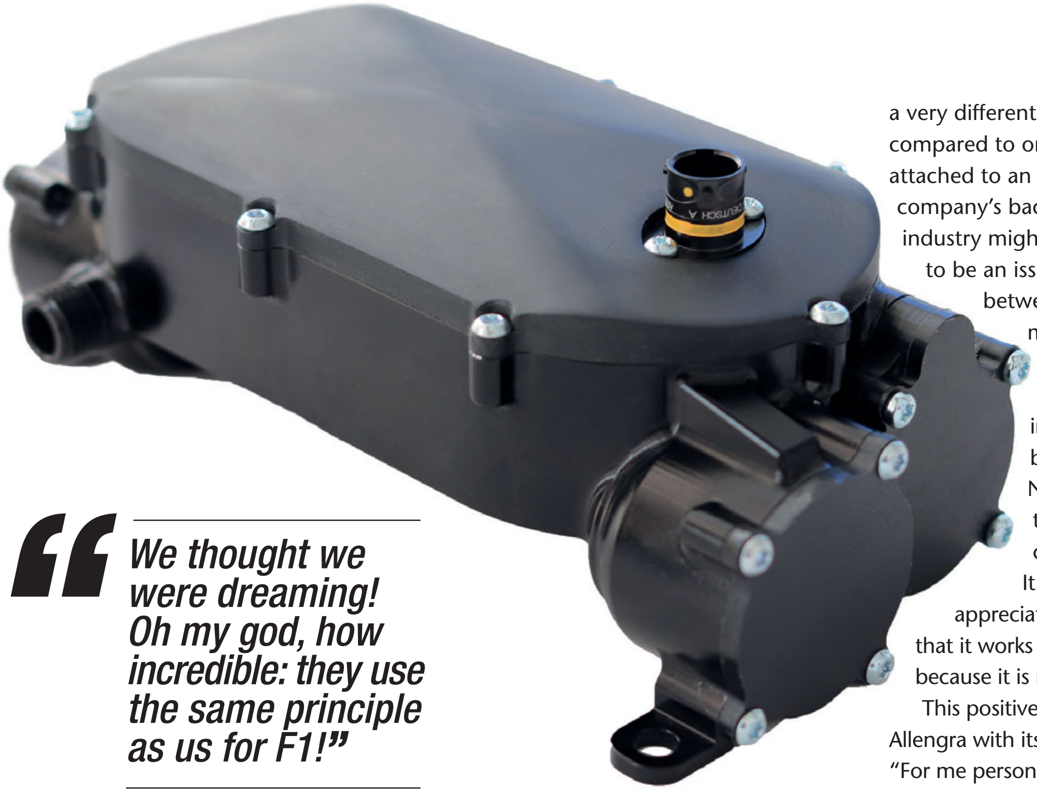
Since the Ferrari controversy, a key FIA requirement in F1 is to beat any opportunity for teams to bluff the sensor into reading less fuel than is actually flowing. The current F1 setup uses two separate FFMs in series, so that the output of one becomes the input for the other. One is the Team FMM and the other the FIA FFM, so the hardware and connections are doubled up. It's up to the team to package these in an efficient way inside the fuel tank.

Beating the cheats

Allengra has developed an all-in-one solution: one housing, one input from the fuel collector, one output to the engine and the separate data connections. This makes the unit simpler to package. The all-in-one setup is enabled by the FIA anti-cheating solution being built in parallel within the unit.

Niels explains their thinking: "The tender of the FIA says you need a sensor that measures with 2 kHz frequency. We believe that a team were scanning this frequency and always between the measurement points they would send more fuel through," he suggests. "The sensor would be flat, but you would actually have more mass sent through…"

Rather than adopt a double FFM setup, Allengra chose a two-tube solution. "Our approach was to use two tubes: one long tube for the high precision as was required by the FIA and works at 2 kHz; then one short tube that works at different ▶



> *We thought we were dreaming! Oh my god, how incredible: they use the same principle as us for F1!"*

frequencies and changes the frequencies all the time," Niels explains.

With the secure and ever-changing short tube measuring the flow, Allengra believes it can beat the teams. "It's the watchdog that's checking if something's going on," he says.

To prove this, the unit was put to the test. "We went to a top F1 team to test if the sensor can be manipulated, by changing frequencies, and the tests were positive for us," he reports. "They couldn't cheat our sensor. In that sense, it looks quite promising."

But Allengra's anti-tampering development goes further still, beyond this twin-tube setup. Rumours are that in the past a team could have previously pre-treated the sensor with a different fuel or gas. This would make it difficult for the sensor to be accurate until it had flushed through, allowing more fuel to flow for a short power advantage at the start of the race. Remember, fuel samples are only taken for analysis at the end of the race. To beat this, the Allengra team have a solution: "We also integrated an internal memory, so that you can read out the sensor's history for the last 100 days."

In addition to the anti-cheating experiments carried out with a top Formula 1 team, other tests were conducted to ensure the sensor was race-ready. These included ensuring it was able to cope with the extreme level of vibration it would experience. A track test with a top WEC squad at the beginning of 2022 further underlined the company's readiness to 'go live' with its FFM.

Race fuel is a very different medium to heating water or coffee, so there was a steep learning curve for Allengra, as Niels recalls: "In the beginning, we started testing with water, because we didn't have experience testing with gasoline. Water has different density and behaviour with temperature. With temperature, the speed of sound changes in water and gasoline: in water, it's a curve; in gasoline, it just goes straight up. It's easier to measure gasoline than water!"

With the sensor now measuring fuel accurately, there comes the final process to ensure the FIA is measuring the teams' fuel as accurately as possible. In F1 and between different race categories, there are different fuels, so the final calibration needs to be conducted for each of these fuels on a sensor.

"Because you have a difference – it's not a huge difference, but in the end if you want the 0.01% of precision, then it's better to have exactly the fuel you need to calibrate," reasons Niels. Therefore, given each team's confidentiality issues, this is a task that must be undertaken by the FIA.

Open arms

A sensor in a boiler fixed to a building, or in a coffee machine on a countertop, lives a very different life, as you can imagine, compared to one travelling around a track attached to an F1 car. This is where the company's background in a different industry might have been expected to be an issue. But the crossover between wider industry and motorsport came as something of a revelation.

"The motorsport industry in general welcomed us with both arms wide open," says Niels. "They were so happy to have a new company coming into this business. It was really nice and I appreciate it a lot. I love the way that it works in the motorsport industry, because it is much more direct and fast."

This positive relationship didn't just help Allengra with its F1 project, Niels explains: "For me personally, I take a lot of this into my other projects in industry. I send out a quick mail here, always thinking that someone would complain, 'Why are you doing that?' Then I'd say I learnt it in F1!"

Coming in as an outsider also brought new insights into supplier relationships in motorsport. "Coming from a different industry, going into motorsport, we realised that many teams and motorsport companies in general when they are looking for solutions, often they are just looking within their field," he observes. "Not every company is as crazy as we are, but sometimes industry can have good solutions.

"Even for smaller teams looking for technical solutions, I'd encourage them to look at companies outside motorsport; sometimes they have some good solutions. Don't be afraid to try it!"

Opening doors

As a new supplier entering the motorsport world, the Junkers have discovered other benefits and opportunities that go beyond the expected FIA/F1 deals. "The funny thing is, after getting into motorsport, many institutes and companies came to us and said, 'We want that sensor for our testing bench, because it's measuring so precisely at 0.5%,'" reports Niels.

It wasn't just the sensor's accuracy that made it attractive, but also its compact nature. "The huge advantage for them is that you can use the sensor on the testing bench test and then put it on the car," he

RIGHT Company founder Raul Junker

LEFT Allengra's fuel flow sensor is tailored for operation in combustion engines under high vibration and quick pulsating flow conditions

says. "We even have a sensor for helicopter testing!"

This new market expansion was a big risk for Allengra, even if it was undertaken as a 'hobby project'. "For us it was a certain risk because before we only worked with OEMs, so everything is financed by our client," says Niels. "Here, we did everything ourselves, financed at our risk. As you can imagine, it's not the cheapest of developments."

However, where the initial plan was just to sell to WEC and F1, other opportunities have arisen. So, what was initially a low-volume niche product turns out to have a wider customer base, perhaps even leading to further product developments from the team. "As we started going to the motorsport trade shows, we realised the huge need for FFMs for other series: lower categories, GT series and even for racing with ATVs," says Niels.

Consequently, there is the realisation that the sophistication of the AL12, with its anti-cheating technology, isn't required for lower applications. Partly this is because the budgets involved don't extend to complicated ruses to beat the FFM, but also because some categories just need a Fuel Flow Meter for data engineering and not regulatory purposes. For this reason, Niels says, the company is working on a simpler version better suited to other categories: "In other series like GTs, it's more for the team to say, 'I want to know how my car is performing.' They would not cheat their own sensor, they just need to trust in the measurement."

The outcome of the 2026 F1 tender is still some way off, but some things are already clear. The journey that Allengra has been on since Raul left his job to start developing ultrasonic sensors, has now brought the company well into the motorsport fold. Its risk has been rewarded with a new suite of customers and markets. RT

BELOW The World Endurance Championship is one of the newcomer's targeted markets, following tests in a Le Mans Hypercar

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KEEP CALM AND CARRY ON

How does Oracle Red Bull Racing principal strategy engineer Hannah Schmitz cope with the demands of making split-second calls on the pit wall? **Tony Dodgins** talks to the first winner of the McLaren Applied Female Engineer of the Year Award

CAN you keep calm in a crisis? It may have been an old wartime propaganda slogan, but it could just as easily have been asked of F1 strategists.

While F1 is keen to promote diversity and inclusion, strategy is an area where women are already doing just fine, thank-you.

McLaren Applied recently launched a ‘Female Engineer of the Year Award’ and its first winner, Oracle Red Bull Racing’s principal strategist, Hannah Schmitz, received her prize at Race Tech’s World Motorsport Symposium awards dinner. Elsewhere, fellow Cambridge graduates Rosie Wait and Ruth Buscombe are heads of strategy at Mercedes and Sauber respectively, and Bernadette Collins recently left Aston Martin to run her own engineering consultancy after two years in a similar role.

Ditch the dolls

Born Hannah McMillan, Schmitz’s German husband, who she met at school, was a fanatical supporter of Michael Schumacher. Formula 1 was already on her radar before a twist of fate helped her towards a Red Bull internship.

“Early on,” she says, “my parents noticed that I was playing with cars and Lego, not dolls. I was more interested in how things worked and putting them together. No-one in my household watched motor racing, but I got interested and dad was into watching any sport.

“I loved maths and physics at school and had a really inspirational teacher. She taught us the application of physics in the real world and that’s what got me interested in cars. I knew I wanted to do engineering in something automotive, and the pinnacle is obviously F1. It was at university that I started to see a route into it as a career.

> “The world champion said of Schmitz, ‘Hannah was insanely calm’”

“The year I graduated I’d been sponsored in London by a building services company, which is where I was supposed to go, but then came the big economic crash and no-one was hiring. Red Bull does a student placement scheme in Milton Keynes and my supervisor from my final-year project, which was doing the suspension for a solar-powered car, thought

RIGHT Top tip: Turning your hands over, palms-down, helps you be clearer and more commanding with what you are suggesting it was something I'd be really interested in. I applied before I'd graduated and, fortunately, within three months of doing that placement, someone resigned and there was a full-time job. I knew as soon as I started that it was where I wanted to be."

Schmitz initially worked in modelling and simulation for 18 months before moving across to strategy. As the team's principal strategy engineer, she rotates circuit-based pitwall duties and Milton Keynes team operation centre roles with the team's head of race strategy, Will Courtenay. The logistics are not altogether straightforward for a mother of two young girls, born in 2019 and 2021!

"I lived in Milton Keynes for a while," Hannah explains, "then ended up going to London for that kind of life. Then when I was pregnant with my first child we made the decision to move closer to our families because I'm away such a lot. I drive an hour and a half each way when I'm in the office but I live close to Heathrow.

"Both my husband and I find that society is not designed that well for both parents to work. We've definitely found it tricky but we work together and everything's 50/50, not always one person's responsibility. That really helps us to deal with it as a family. We both took six months' parental leave and both understand what it's like to be a parent at home and at work.

"He has to do a lot on his own when I'm out of the country but that's why we ▶

All photos: Getty Images/Red Bull

RACE TECH
WMS
World Motorsport Symposium
ner : Hannah Sc

ABOVE Collecting the Female Engineer of the Year accolade, from McLaren Applied's Pauline McFerran, at the Race Tech World Motorsport Symposium awards dinner

live close to our families. We have that support. It's hard, but I feel like I'm doing something that my children can watch on TV and get really interested in.

"It was 'Dress up as you want to be when you grow up day' at school recently and my daughter chose to be a race engineer wearing a little Red Bull T-shirt. I thought, 'Ahh….' It makes it worth it.

"My husband works in the City, has a high-pressure long-hours job as well, but doesn't have to work weekends and has the flexibility. We both really wanted to have a family and continue our careers, so we work hard at it. Some weeks it works well and some weeks it feels impossible!"

You might imagine that given the domestic situation, Schmitz may favour the factory role, but that's not the case.

"I prefer the on-site pit wall for the control and adrenaline," she admits, "but what makes us strong as a team is Will and I rotating. Because in the operations room there's always someone who knows what it's like to be the person trackside, making sure that all the information going across is exactly what they want to hear.

"The support we have between ourselves is really powerful. Then having a bit of time in the country helps with the tiredness, so it works well."

So, amid the highly-charged testosterone of the F1 pitlane, was it tough to establish trust?

ZERO
HAMILTON TARMAC
ORACLE

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ROLEX

> I sensed just a bit of resistance initially and thought to myself, 'Are you going to be able to do this?'"

ABOVE & LEFT An inspired call for intermediate tyres in Monaco conjured an unlikely victory for Sergio Perez from underneath Ferrari's nose

"Yeah," she smiles, "and with strategy you're making decisions and calls and telling people what to do. So, you have to establish trust whatever your gender, but I think maybe it was tougher because a female hadn't done it before.

"I sensed just a bit of resistance initially and thought to myself, 'Are you going to be able to do this? Do you actually have that confidence? And will people listen to you?' But it didn't take too long for that to be the case. It takes quite a while in terms of training but I was coming from a graduate level and since I've been doing the job I've never had any issues."

Bold call

Schmitz has been publicly in the limelight more than once. At one of her first races back from maternity leave in 2019, the Brazilian GP at Interlagos, Max Verstappen had taken pole position but fallen behind Lewis Hamilton after the first pit stops, before fighting back past. When a safety car appeared with 17 laps to go, Hannah made the brave call to give up the lead and pit Verstappen again. It secured the victory and team principal Christian Horner sent her up onto the podium to collect the team trophy.

"Max had already passed Lewis once before in the race," Schmitz says by way of explaining a strategy 'gamble' that raised a few eyebrows. "That gave me the confidence to make the call. Without that, maybe I would have been more hesitant but it comes back to being in control. If you make the stop, you are the one attacking, with things to gain. And Max drives very well in that situation.

"We were discussing it on the pit wall and nobody could make their mind up because it was in a grey area. So, I said, 'Okay then, this is what we're doing."

Ross Brawn has admitted that Michael ▶

Schumacher's prowess afforded Ferrari some strategy options they may not otherwise have had, and you could say the same of Verstappen, but Schmitz is at pains to acknowledge that it's very much a team effort: "We also have a really good pit crew and the whole team works really sweetly. You can rely on everyone, which obviously helps."

Monaco mayhem

And then there was Monaco 2022, which Red Bull really had no business to win after Ferrari locked out the front row at a track where overtaking is nigh on impossible. But the heavy rain beforehand and constantly evolving track conditions threw in a curveball. Red Bull pitting third-placed Sergio Perez first, on lap 16, to go onto intermediate tyres for a short stint before switching to dries, won them the race, while Ferrari opted to go straight from extreme wets to dries with Carlos Sainz and cost Charles Leclerc the race with poor calls.

At the back, an out of position Pierre Gasly had made an early switch to intermediates but was not a good performance barometer because he was in traffic, but as soon as Gasly had some free air, Schmitz was straight onto it and made the call.

"We have a few software tools that we've written in-house to try and help us in the wet with those calls," she explains. "We've got sector times to monitor and an idea of the profile those times might follow, but Monaco is a very difficult race with the lack of overtaking so already quite high pressure.

"Then, with the conditions changing as well, it's about getting the right information: What's happening with the weather? What's happening with the lap times? What do we want to do? And it's also one where you can go straight from extremes to dries, as Ferrari tried. Do we want to do that? Do we want to go to the inters? There's so many things to think about. It's about being calm and having the confidence to make those calls. You don't ever know that you're 100% right. You have to go with what ▶

LEFT Everybody knows you can't overtake in Hungary, so plotting a strategy for Max Verstappen to win from 10th on the grid really was cause for celebration

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LEFT Schmitz is a recognisable face to F1 fans after being beamed around the world at the Brazilian GP in 2019, where she was invited to collect the Constructors' trophy

you think, then try to justify it afterwards, hoping you're mainly right!"

Post-race, Red Bull's Helmut Marko gave Schmitz much credit for the Perez victory.

One question pondered was, if it had been the right call to pit Perez on lap 16, why did Red Bull wait until lap 18 to bring in Verstappen – the same lap that race leader Leclerc stopped – rather than pit him on lap 17?

"We were covering Ferrari," Schmitz explains. "It's never just about us, it's always about what the other teams are doing. Before a race we'll work out what's the fastest way to the end, etc, but you hardly ever end up doing that because we're not racing on our own."

A couple of months later after Verstappen had won in Hungary from tenth on the grid after a good eleventh-hour tyre call, the world champion said of Schmitz, "Today, Hannah, our strategist, was insanely calm. She's very good."

It's something Schmitz works at. As well as yoga, she has adopted body scan meditation as part of her daily routine.

"That mainly came from my maternity leave," she says, "because having a newborn baby I did actually find a bit more stressful than F1!

"Also, on the pitwall, something that someone taught me quite early on when I was trying to gain that trust with everybody and come across quite assertive, was putting the palms of your hands down when you're talking. If you want to make a statement or sound like you're in control, turn your palms that way and you actually talk with a lot more gravitas. You're much clearer and calmer. And that's actually a ▶

> *"You have to establish trust whatever your gender, but I think it was tougher because a female hadn't done it before"*

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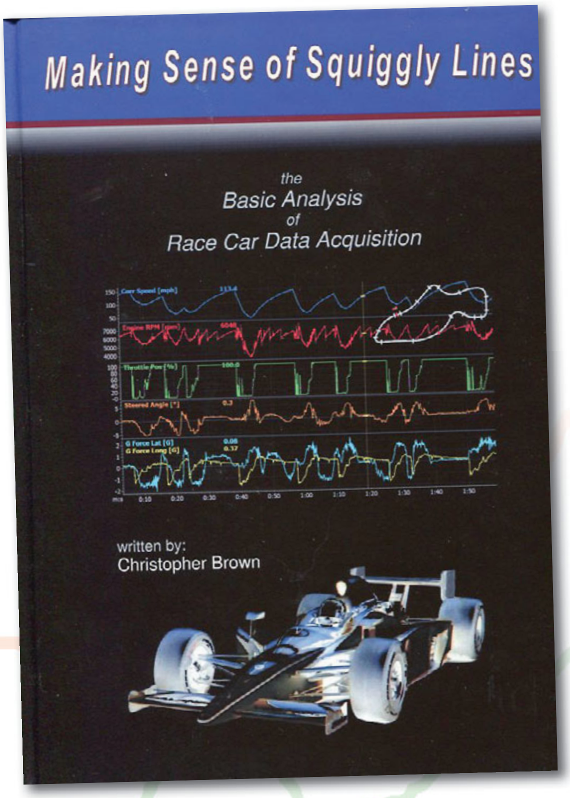
The Basic Analysis of Race Car Data Acquisition by ***Christopher Brown***



Making Sense of Squiggly Lines

the
Basic Analysis
of
Race Car Data Acquisition

written by:
Christopher Brown

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help on the pit wall with lots going on. Just that action helps centre you.

"Because it doesn't always go right. Brazil, for example, has been good and bad. There was that great 2019 race but then there was the year it was really wet, then the weather kept changing and we kept changing tyres. I came away feeling I hadn't really been in control enough. I didn't feel that I'd done a good job. But at every single race there's something I feel I could have done better. You'll have highs and lows throughout a race. And, you can kind of over-analyse everything."

No blame game

Part of the reason Schmitz gets so much from the job and willingly takes on the

RIGHT Schmitz helps make key decisions after analysing live race data

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BELOW & LEFT Being on the right tyre at the right time was key to Verstappen's stunning win in Hungary

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responsibility, actively craves it in fact, is the lack of any blame culture within the team.

"Will and I discuss every race in detail. We talk over everything with the whole department, everybody gives their opinion. We also talk to the race engineers, who might have different opinions on what went right and wrong. But there's never any blame. It's more, 'let's just talk about it.' You never feel defensive and are open to sharing ideas. It's a good environment and many people end up staying at Red Bull a long time. It's a really nice team."

> *I found having a new-born baby more stressful than F1!"*

Most stress, Schmitz suggests, comes more from the constant travel rather than from her actual working environment.

"It's not like we're just plucking a decision out of the air that people don't already understand the reasoning behind, so it helps that we work as a team. At the end of the day, some decisions are completely on your head, like a safety car decision when there's not a lot of time, and I take responsibility – but that's something I've always liked.

"Feeling in control and in charge and having that responsibility – I think that's when I do best. It's a lot of pressure and time pressure but you get so much adrenaline in the race, which I really enjoy. More stressful is the travelling and trying to balance family life."

The ever-expanding F1 calendar, looking towards 24 races, is not making that any easier. Is it something she wants to, or can sustain?

"It does make you think," Schmitz admits. "It's particularly difficult for people who travel to every single race. And, obviously, we're still working a race even if I'm not travelling to it, so I've still got my 90-minute commute each way. It does put a lot of pressure on the rest of life. But it's enjoyable and so it's a balance, isn't it?

Inspiring

"Usually if it's a flyaway race we might get just a day to acclimatise and if it's a European race we'll go out for dinner, so you don't get time to do the touristy things but you still get the atmosphere of the place. That's inspiring and makes you see why you're doing what you're doing.

"Having children, we obviously had a chat about whether it was still viable. But I'm doing a job that I really love and I don't see why I would want to give that up. I love it and as long as I do, I'll keep doing it."

Spare time, then, is a rare commodity, but should it arise, you are likely to find one of F1's sharpest thinkers indulging in board games.

"This might sound a bit geeky," she smiles, "but my husband and I are really into them. We've got a massive collection and play some quite intense ones that take quite a lot of hours. Our friends are into it too, so it's quite a social thing. Some of them are quite obscure but growing up, Cluedo was the one. If I hadn't been an engineer, I'd have wanted to be a detective!"

Clearly, The Met's loss is Red Bull's gain. RT

STUNT KING WHO RULED OUR DREAMS

F1 World Champions and rally legends alike paid tribute to Ken Block when he died, so what sort of legacy will the YouTube sensation leave? **Hal Ridge** investigates

IN the days following the tragic death of American motorsport star Ken Block in January, a simple extract from an interview posted on Instagram went viral. It was fitting for a man best known for his viral Gymkhana videos online.

On the DC Shoes Instagram channel, the clip was published as a reel, with Block being asked: “What would you consider your legacy and where do you go from here?” His answer: “I try and inspire people to be creative and live a fun life, and don’t be an asshole.”

Over the next two weeks, the video would be viewed four million times.

Block stepped into motorsport relatively late compared to most top names, having co-founded the DC Shoes brand in 1994. A decade later, he sold it to Quicksilver for an eye-watering sum. He didn’t begin his rally career, in a Subaru, until 2005, aged 37.

In his life as an entrepreneur, Block was a man used to signing off sponsorship cheques. DC was a trail-blazer in aligning with pro athletes to market its products, people aspiring to be like their, branded, heroes.

Block was therefore arguably more aware than any driver before him of the requirement to give sponsors return on their investment, more than just a sticker on a car. The trend he started with DC continued through his motorsport career as gamekeeper turned poacher in securing the support to execute his new endeavours. The ultra-successful Gymkhana series, the choice of championships and events he participated in, and the content he and his team produced was all meticulously considered. The Formula 1 elite aside, no individual in motorsport has reached a wider audience.

But under his larger than life character, Block was an enthusiast for cars, driving and competition. As such, the range of machinery his team created for over a decade offered his partnering brands great exposure and gave pleasure to those watching at the most basic level. But beyond that, just like an episode of the American animated sitcom ‘The Simpsons’, Block’s exploits – especially his Gymkhana videos – could be viewed from many perspectives.

Just as a child and an adult can watch a Simpsons episode together and find amusement on different levels, so Block’s projects have exuded the same appeal.

Block did things in a unique fashion. He was creative, pushing the boundaries. His unfettered creations made the technical side attractive, inspiring people, especially the young, to undertake their own projects and become better versed in technology.

Inspiration

Fuelled by a love of enthusiastic driving, Block’s motorsport career started with Subaru, rallying a Vermont SportsCar-run Impreza in 2005. His Gymkhana concept was inspired by the Southern California-based Gymkhana USA series that expired before Block’s first Subaru to partake in such a discipline, prepared by Crawford Performance, was ever finished.

The first video in what would become the sensationally successful Gymkhana series was entitled *Gymkhana Practice*, as it was just that: Block practising proximity driving and the Gymkhana concept in an open area.

From that relatively standard machine, Crawford Performance created a next generation Subaru for the

RIGHT Ken Block’s partnership with Audi unlocked the door to machinery he had dreamed of

Audi AG

second instalment: *Gymkhana Two: the Infomercial*. But it was a commercial switch to Ford for 2010 that took Block down an extreme path of bespoke performance machines, for both competing and filming alike.

It would be impractical to document all of Block's creations within the space available here, such was the extent of what he and his team created in such a relatively short period. But there were key cornerstones in the evolution of the machines.

Rallycross outfit Olsbergs MSE was enlisted to adapt its 600 bhp, four-wheel drive racing machine for rally and X Games use. While Block won once in the 2010 Rally America campaign – with the Monster World Rally Team as it was titled thanks to his partnership with the energy drink brand – the double-wishbone suspension of the rallycross machine didn't have the travel required for rallying exploits. Reliability was also an issue.

The concept was retained for a bespoke *Gymkhana 3* machine. While Alcon brakes, Öhlins suspension, a Mountune engine, and MakTrak gearbox (now SGS Racing Transmissions) were retained, an electronic paddleshift system was used for the transmission. The water cooling was moved to the front of the car (from the rear in a rallycross layout) and the power output was significantly increased.

The team switched to creating a Fiesta based on ▶

WELCOME
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Audi AG

an M-Sport WRC body shell for its next creation, the HFHV (Hybrid Function Hoon Vehicle), intended for use in Gymkhana, rally and rallycross. It featured a Garrett turbocharged Pipo Moteurs 350 bhp engine, essentially borrowed from a Focus WRC, was powered by Cosworth electronics and utilized a Sadev sequential transmission, Reiger dampers and Brembo brakes. That car shared its foundations with the RX43 rallycross-specific machine that followed for use in Rallycross America and a step into the World Rallycross Championship.

"When I started with Ken it was mainly setting the rally team up to take on Vermont SportsCar, and there was a fight between Travis [Pastrana] and Ken," explains Hoonigan Racing Director Derek Dauncey. "We went on to build the first Fiesta we did ourselves [the HFHV], which we called the transformer. Malcolm [Wilson, M-Sport owner] supplied the chassis. That was the first year we were technically involved, trying to piece that car together, which wasn't easy.

"It was a bit raw. We were short of design and testing time, but it was a really good challenge. After that, we were quite keen to move to a more competitive rallycross car, so went back to Malcolm and had about 10 different points on the car that we wanted to change. That car was really quick.

"At that time there was a massive unknown as to whether the American cars and drivers were quick enough to compete in the World Rallycross Championship, so we were keen to bring that car across and we were really quite successful at events in Norway and France."

While it's in those Fiestas that Block became best known, it's the more bespoke creations that have arguably fired the imagination of viewers the most. Perhaps none more so than with the famous Hoonicorn.

Ford

Born in a caravan

"That concept was basically born in a caravan at Santa Pod," says Dauncey. "We were doing some demo work for Monster Energy, and Ken said he wanted to build a '65 Mustang which was four-wheel-drive and had a V8 engine. The project was born and that became an iconic car."

Although based on a '65 Mustang, the car actually shared incredibly little with the standard machine. It was built on an ASD Motorsports-designed tubular chassis, clad with carbon fibre bodywork.

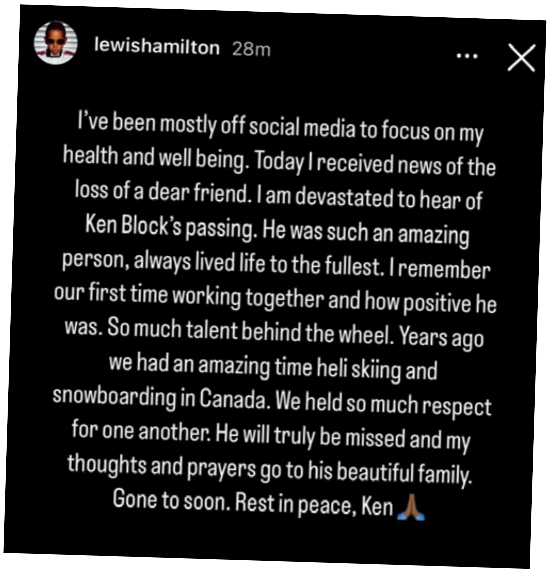
The Roush Yates 410 cubic inch Ford V8 engine with individual throttle bodies produced 845 bhp and 976 Nm torque, driving all four wheels through a six-speed Sadev transmission. The performance was put to the ground on ASD Motorsports custom front and rear pushrod suspension.

The Hoonicorn, built for the filming of *Gymkhana 7*, is supreme engineering, but was superseded by a V2 evolution. A pair of Garrett turbos and a Switzer Dynamics intake manifold with methanol injection were added to develop an eye-watering 1400 bhp and 1700 Nm torque. The car was first used for filming *Climbkhana: Pikes Peak*.

So how did developing an existing platform – turning M-Sport's WRC machine into a rallycross contender, for example – compare with building some of Block's ground-up programmes? "Both had their challenges," Dauncey explains. "It was great to work with OMSE the first year with Ford, but we were trying to make a rallycross car with limited travel do rally, so everything that we did was different.

"With the HVFV, we wanted to fit the two-litre engine, so we had to convert and modify everything to fit between the chassis rails. There were always compromises and everything was always done to a timescale, so you never really had proper design time to be 100%; it was modifying as you went along.

"The Mustang was just a complete one-off build. Ken was good at challenging you. He was a visionary and in his own head he would know what the car would look like from an appearance point of view. Then we had to ▶



I've been mostly off social media to focus on my health and well being. Today I received news of the loss of a dear friend. I am devastated to hear of Ken Block's passing. He was such an amazing person, always lived life to the fullest. I remember our first time working together and how positive he was. So much talent behind the wheel. Years ago we had an amazing time heli skiing and snowboarding in Canada. We held so much respect for one another. He will truly be missed and my thoughts and prayers go to his beautiful family. Gone to soon. Rest in peace, Ken 🙏

ABOVE How Lewis Hamilton reacted to the news

> "As the entrepreneur-turned-motorsport visionary, he inspired a generation"

ABOVE Block and the Audi S1 Hoonitron electrify Las Vegas

LEFT The only all-wheel drive performance Mustang ever built, the evolution of the Hoonicorn produced 1,400 bhp

Ford

MONSTER ENERGY
DiRT2
PIRELLI
Rally America

RIGHT Early days with the Monster World Rally Team Fiesta make it work for what we needed to do with it. But as long as we kept within his design parameters, you were quite free to get it to work technically. All the time we needed it to be able to perform in front of the camera, or be as competitive as possible. It's a fine line.

"Time was always an issue: it was tight when we were doing these projects and taking them around the world. We had the Mustang go up Pikes Peak to shoot *Climbkhana*. That was incredible access that the organisers gave to run up the hill. We went to China; we took the cars everywhere."

Hoonitruck heads for China

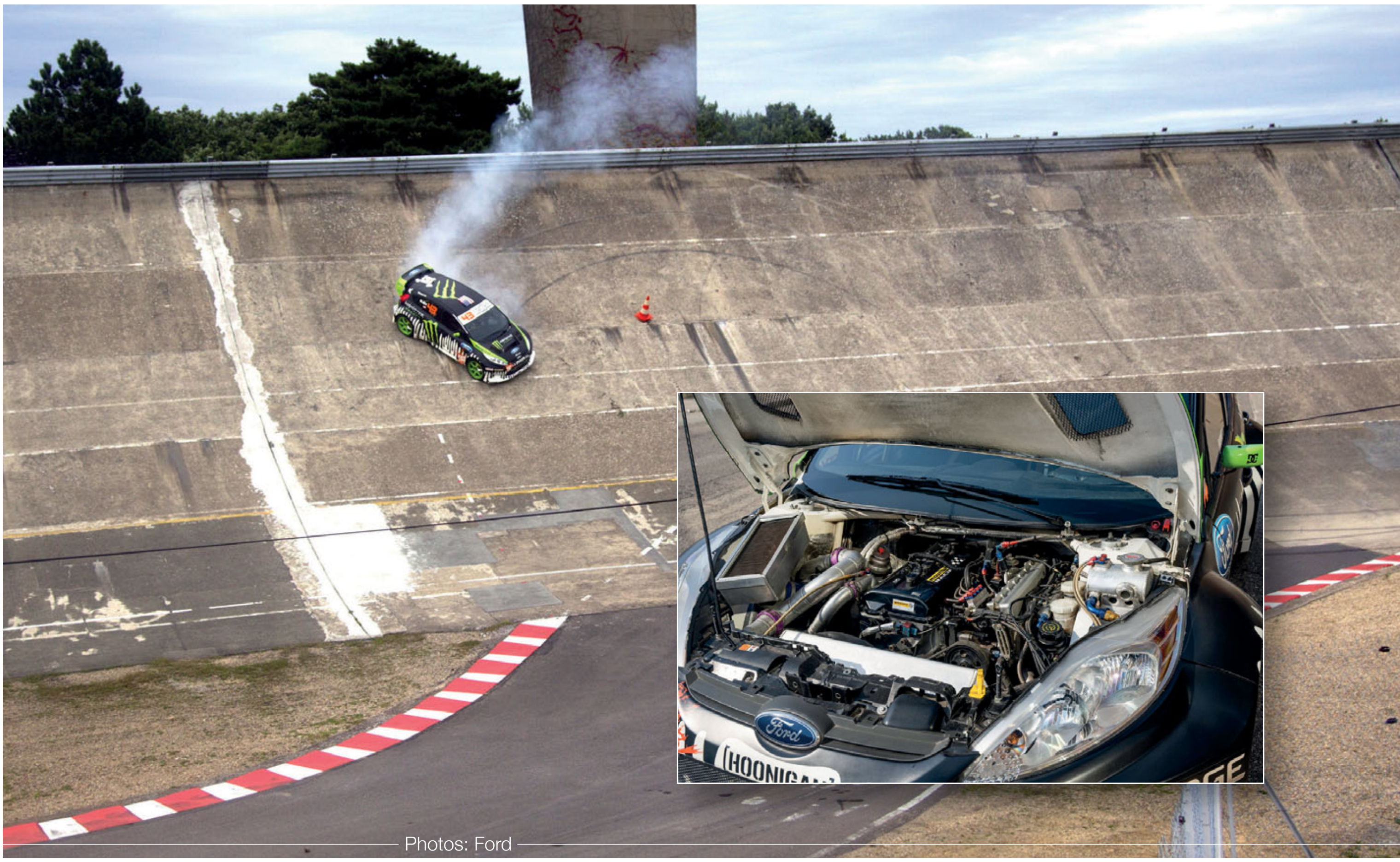
That spaceframe off-the-wall concept was carried into the Hoonitruck in 2018, a 1977 F-150 truck that went to film in China. Again based on a spaceframe chassis, but this time clad in hand-hammered military-grade aluminium bodywork, it was powered by a custom-tuned, 3.5-litre, twin-turbocharged Ford Performance/Roush Yates EcoBoost V6 engine with a billet-aluminium block lifted directly out of the Ford GT Le Mans development program. It delivered 914 bhp and 950 Nm torque, and was once again mated to a Sadev four-wheel drive transmission system. Fantastically, the Hoonitruck had a tow hitch!

The more extreme creations weren't all about performing tricks for hit videos, however. This was arguably most evident with the Global Rallycross ▶

Monster Energy

LEFT The ever more extreme theme led to the Hoonitruck, a spaceframe 1977 F-150 truck that went to film in China

BELOW & INSET The Gymkhana 3 creation moved the water cooling to the front of the Fiesta, a trick borrowed from rallycross



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programme in the RX43 Fiesta and the Ford-backed effort in the World Rallycross Championship, the Ford Focus RS RX. The latter, campaigned in 2016 and 2017 by Block and Norwegian Andreas Bakkerud, was taken to event wins and podiums, the car created between Hoonigan, Ford and M-Sport.

Under Hoonigan's own auspices, Block campaigned a Group A-based Escort Cosworth, until it caught fire and burnt out. The replacement version of the car, of course, had to be far more extreme: a modern take on the classic concept, the Cossie V2 was arguably the most wild-looking Escort RS "Cossie" ever built. The project aligned with Cosworth engine expert Julian Godfrey Engineering and MDV Specialist Engineering, both in England, and had bodywork design courtesy of Ash Thorp. The car featured an aluminium block, IHI turbocharger (with 34 mm restrictor), Sadev transmission, Cosworth electronics, AP Racing clutch and brakes, and Reiger dampers.

All right on the night

As with all of Block's projects, timescales were short, but under Dauncey's guidance, they always got done. "Normally there isn't a massive amount of time before you're going to the first event or the first filming," he recalls. "It's an unknown; you just hope that everything's going to work and we can deliver what's required. It is tense before you run it properly for the first time.

"When we started filming with the Mustang for the first time, we used a 40-metre by 40-metre car park the night before; that was it before we were in Los Angeles filming with Ken going through a lot of visual furniture on set to do the first trick! That was a sleepless night waiting for that one to happen. You have to better the previous project, otherwise you're not delivering on what people expect."

The more recent projects included a 2022 Rally America programme with an adapted Hyundai i20 WRC car operated by French outfit 2C Competition. It was a bid for the title, which so nearly came off in a fierce fight against Vermont SportsCar's works Subaru effort.

There was also a foray into the East Africa Classic Safari Rally, with a Tuthill Porsche 911, and an effort to take on the Pikes Peak International Hillclimb in the Hoonipigasus last year. This was a wild, spaceframe chassis, Porsche 912, boasting a flat six, twin-turbo 1,400 bhp engine with the propshaft actually travelling through the cockpit.

Beyond those, it's to Audi's mast that Block's colours had been tied.

It's a mark of the strength of his brand that even at 55 years of age, Block ▶

ABOVE The competition plans didn't always go to plan. The RX43 is captured here in an unscripted stunt in Global Rallycross

HOONIGAN
Ford

Monster Energy

RIGHT The most extreme Escort RS "Cossie" ever built?

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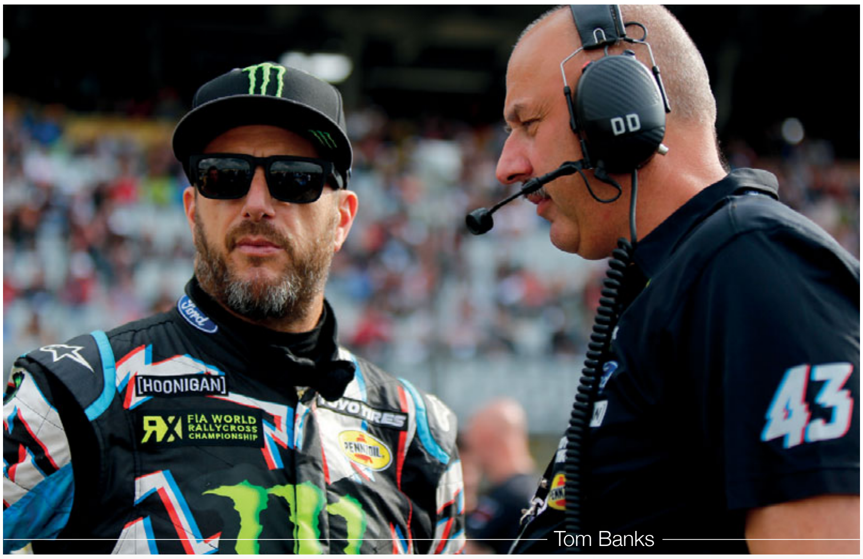

Tom Banks

remained totally relevant to a young demographic. As such, a partnership with Audi not only gave Block the opportunity to sample boyhood dream cars from the four-ring firm's stable, but to work on making the future attractive too.

The Audi S1 Hoonitron featured a composite chassis with a pair of motors borrowed from Audi's Formula E project, running at 800V, driving the wheels via a single-speed transmission with limited slip differentials, producing 3,000 Nm torque. It was used for the *Electrikhana* film, shot in Las Vegas.

"It became clear very early when we ran the HVFV, it became a formula really, that for filming you needed 700 bhp at the wheels, using the Toyo Tires show tyres," reflects Dauncey. "Then the Mustang had 1,400 horsepower. I used to detune it because Ken would be in fifth gear spinning the wheels, just hammering the car. He could do a set of tyres in a minute and a half, so our band of performance was modelled into that; visually, it doesn't matter if you're smoking the tyres at 700 or 1,400 horsepower, the reliability was there with the transmission side.

"We found a model that worked. The strange thing is we've recently moved over to work with Audi, and we were able to give them the gear ratios, power and car setup, which was able to help them with the initial chassis building and the target values for the engine side. To be fair to them, they took a massive design jump. We filmed in Las Vegas [for *Electrikhana*], but we also shot a film at the end of last year which hasn't come out yet, with a sequential gearbox concept running through the electric motor. That was a brilliant solution, and that was driven on what we needed to do the donuts and tricks we wanted to do."

As Billy Joel famously suggested, 'Only the good die young'. Ken Block certainly fell into that bracket. As the entrepreneur-turned-motorsport visionary, he inspired a generation the rest of motorsport has struggled to engage.

Going full circle, the last two *Gymkhana* films in internal combustion engine machines have been shot using cars created by Vermont SportsCar, with whom Block made his motorsport debut. His friend and rival, Travis Pastrana, took up the driving mantle, following in Block's wheeltracks even before his premature demise.

Mobil 1
HOONIGAN
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TOYO TIRES
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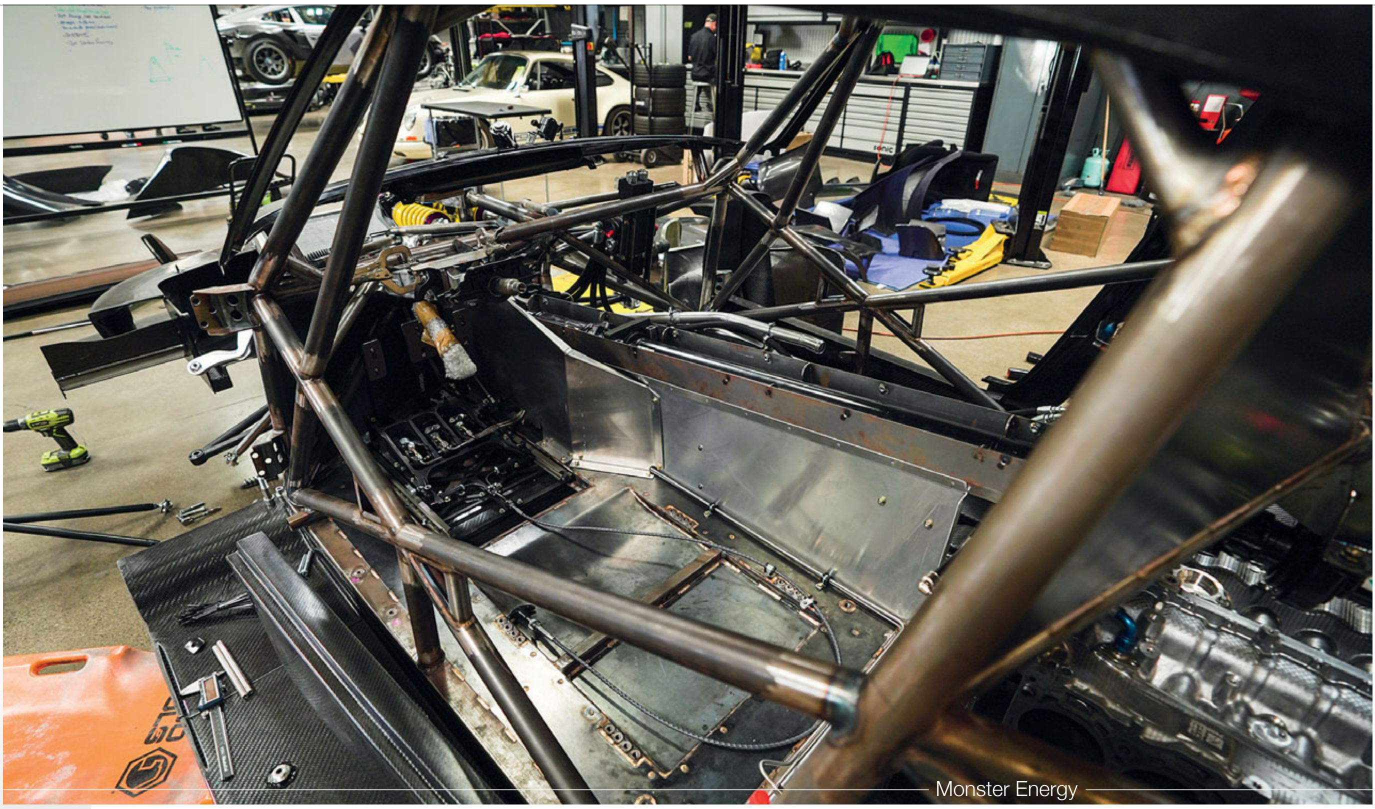
Monster Energy



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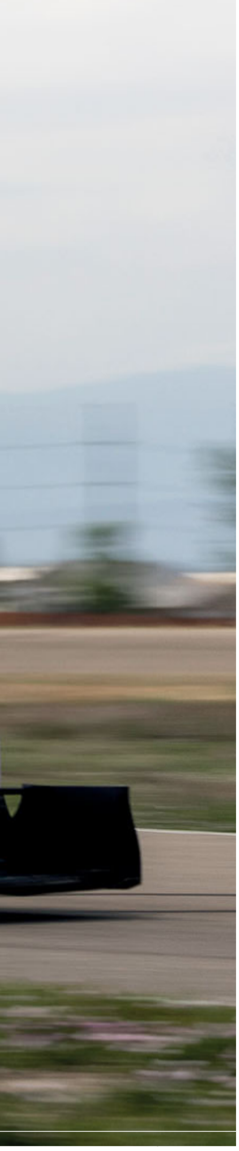


LEFT Hoonigan Racing Director Derek Dauncey was often the man tasked with turning Block's visions into a reality

LEFT & TOP Block will be remembered for his creativity, exemplified by the 'Hoonipigasus' devised for Pikes Peak. Moving the engine from the rear of the Porsche to a mid-position necessitated running the propshaft through the cockpit

Block's death made lunchtime BBC Radio news in the UK. It's highly unlikely that, outside of the most famous Formula 1 drivers, such airtime would be given to any other motorsport athletes.

That's indicative of the reach the American star has had around the world, and the influence he inevitably exerted over his fans.

A great example of his ability to influence technology and to intrigue with his creativeness is within his own Hoonigan concern. It has grown exponentially in recent years, outside of Block's own exploits, with no involvement from the 'Racing Division' of the company.

Birth of the IndyTruck

Last year, aligning with HPD (Honda Performance Development), Hoonigan employees mated a 2.2-litre, twin-turbocharged, ethanol-fuelled V6 700-900 horsepower engine from a 2022 IndyCar to a Honda Ridgeline-based chassis. The result, the wild IndyTruck, was intended to take on all-comers on road courses and hillclimbs. HPD was happy to co-operate, knowing it was a no-lose scenario. On the one hand, it would benefit from the brand's global footprint; on the other, it genuinely appealed to the talented young engineers it had coming through its own ranks.

"It was 16 years with Ken for me, 13 years of our own team," says Dauncey. "We had incredible reach with the videos and technically we received a lot of questions about the cars. What Ken did drove a lot of people who were armchair enthusiasts to go and try something different for themselves. His clever concept of marketing made a massive impact.

> *"Even at 55 years of age, Block remained totally relevant to a young demographic"*

"Technically, we've gone from different concepts to cool liveries on the cars and Ken's suits. His larger-than-life character has basically set a standard and he's gone across so many different motorsport formulas and shown people how to market their own ideas and concepts; it's been bi-lateral really."

Human intrigue means Block's videos have received a huge amount of views, likes and comments since his passing, with fans and followers paying their respects from around the world showing the mark he has left.

Those commenting ranged from Formula 1 drivers (notably world champions Lewis Hamilton and Jenson Button), to world rally legends (Sébastien Loeb and Sébastien Ogier), and from F1 team principals through to FIA president Mohammed Ben Sulayem.

The top comment on one of Block's videos reads: "To see Ken Block is gone is truly sad for me. All those cars that he drove over the last decade is something to see, it makes me wanna build my own Gymkhana car. Thank you Ken for everything that inspired and motivated me. #43VER."

Taken too soon, Block's influence in inspiring people to push the envelope and be creative will live on as his legacy. RT

ENDING THE PAIN IN THE RAIN

With the FIA researching solutions to improve visibility for F1 drivers in wet weather, **Sergio Rinland** says let the teams do the work…

THE new Formula 1 aerodynamic rules have proved to be the right way forward, despite last year's issues with porpoising. Not only have the teams found solutions, but the small tweaks of the rules for this season will help to make those solutions permanent. We saw during the Bahrain tests that only Ferrari showed some degree of porpoising, but nothing compared to last year.

Despite all the positives, there remains one issue: the new aerodynamic behaviour of the cars, or the air behind the cars to be more precise, which has prompted drivers to complain that this new aero makes for worse visibility in the rain. Hence, the FIA's aerodynamic team is investigating this issue, to the point that a 'wet weather body kit' could be mandatory for wet races in 2024.

The problem here is: what happens if it starts raining in the middle of the race? Will a tyre pit stop also be a 'wet weather body kit stop' as well? Not very practical in my view.

For many years there have been techniques using Computational Fluid Dynamics (CFD) to study the behaviour of liquid droplets moving with the air stream. The road car industry uses these techniques to study the dirt deposits on cars' sides and rear windows, lights and mirrors, finding solutions for their designs.

So, why don't F1 teams use their powerful CFD tools to study this and improve driver safety? The answer is simple: this will not result in faster cars and, if you will, that is the problem of the car behind. Let's not forget here that motorsport engineering is all about making faster cars, so unless it is mandatory or prohibited, F1 engineers will not volunteer to make the cars safer if that makes them slower, period!

Self-certification

We have been insisting on these lines for many years about 'self-certification procedures'. But it seems that this idea does not sit well with F1's perceived DNA, unlike in LMH/LMDh where it works perfectly – the ACO takes the full-size cars to the Sauber wind tunnel to validate the CFD results handed over by the teams. In both series the cars are scanned in scrutineering to ensure they follow the same surfaces as the homologated CAD.

Trying not to be too invasive, this kind of methodology could be used by the FIA, dictating only a procedure for F1 aero teams to follow in order to demonstrate that their cars do not send unwanted water droplets directly to the visual area of the following drivers. The results could be presented in a CFD study, along with the car's surfaces, to the FIA. Let the teams find the best solution, but make it 'mandatory' for safety reasons.

That way, all that the FIA needs to be interested in is the criteria used to decide what is acceptable for the driver behind; let the teams find whatever solution they want, so long as it demonstrates that it complies with the criteria.

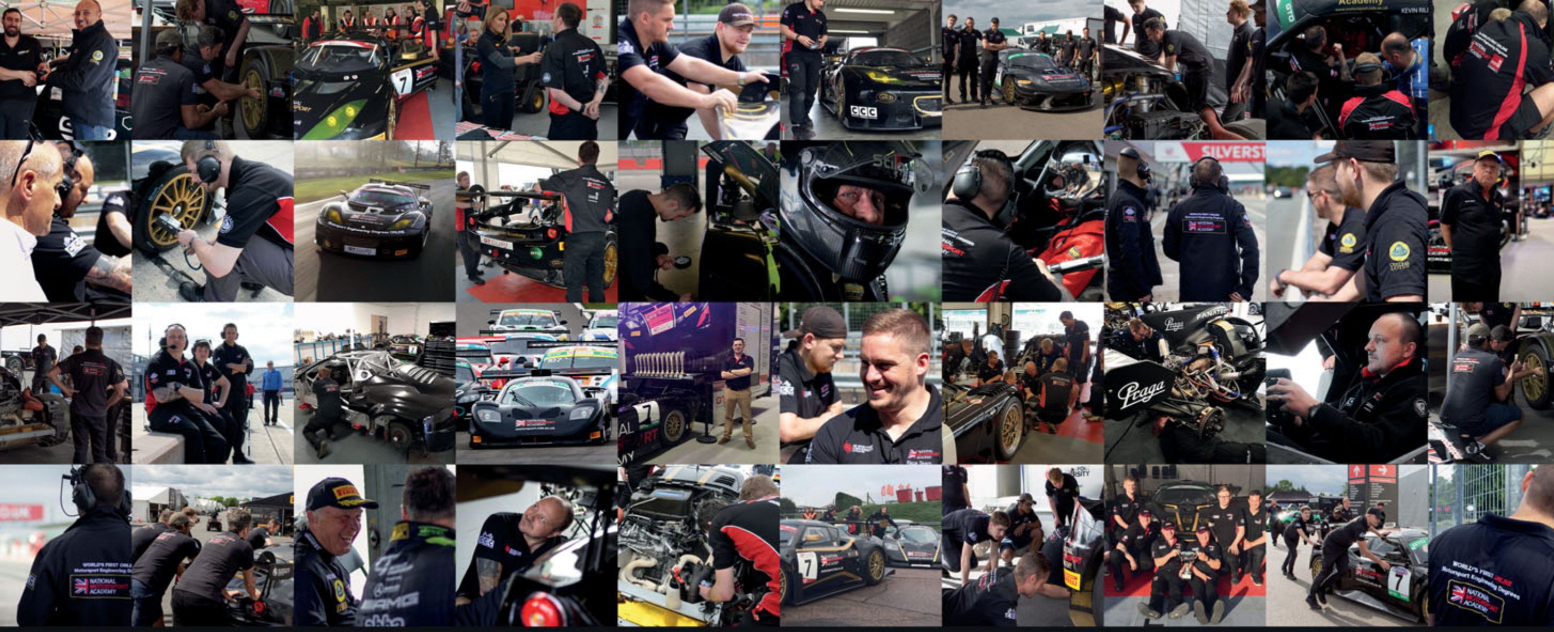
Otherwise, it will be a saga, as it has been for more than 100 years, where the governing body decides where to put or not put bodywork because in 'their car' it does the job. In reality, though, it will affect various cars in a different way: every engine cover and wing design is bespoke, hence different airflow patterns, and some will be benefited by the rules and others not.

Going back to the self-certification concept, if it works in the automotive industry to certify crash tests with Finite Element Analysis (FEA) tools, then surely it could easily work for F1 teams to certify the wet weather safety of their cars with CFD tools? After all, the technology is there: it has been part of CFD procedures for a long time.

In the automotive industry, if a car in a crash does not behave as it has been certified and a passenger is injured, the engineer in charge is in trouble, so nobody cheats. In the same way, if a car in front is sending more water droplets than certified to the one behind, reducing its driver's visibility, the designer will need to prove why. Otherwise, his car could be disqualified. No more argument. RT

URALKALI
URALKALI
ASTON MARTIN

LEFT Decreased visibility for following cars was an unintended consequence of the new aero package



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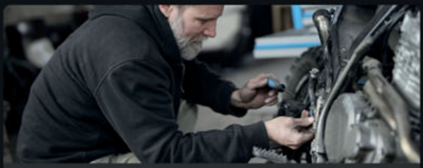

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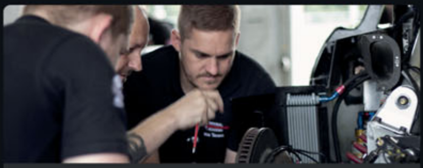

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